The Bulletin

of the

American Association of Nurse Anesthetists

FEBRUARY

1943

VOLUME XI NUMBER 1

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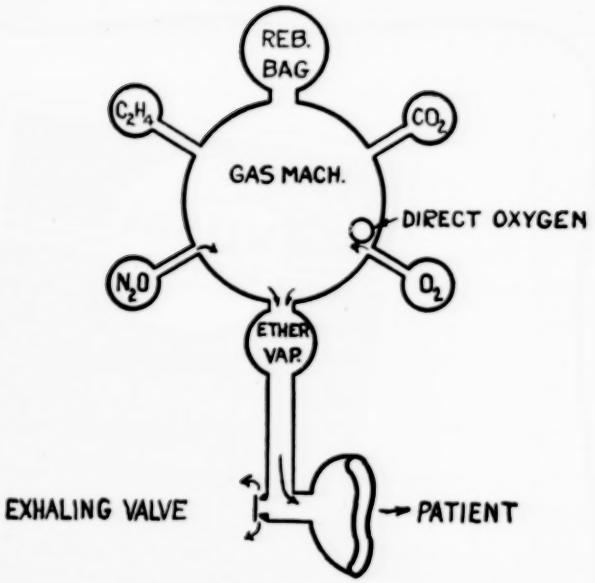

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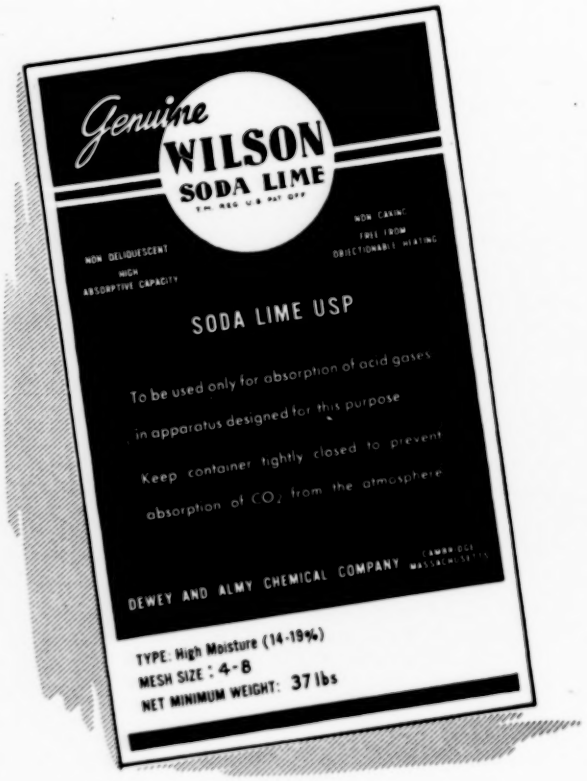

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[1]Romberger, Floyd, T.: *J. Indiana S. M. A.* 35:613 (Nov.) 1942.

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BULLETIN OF THE AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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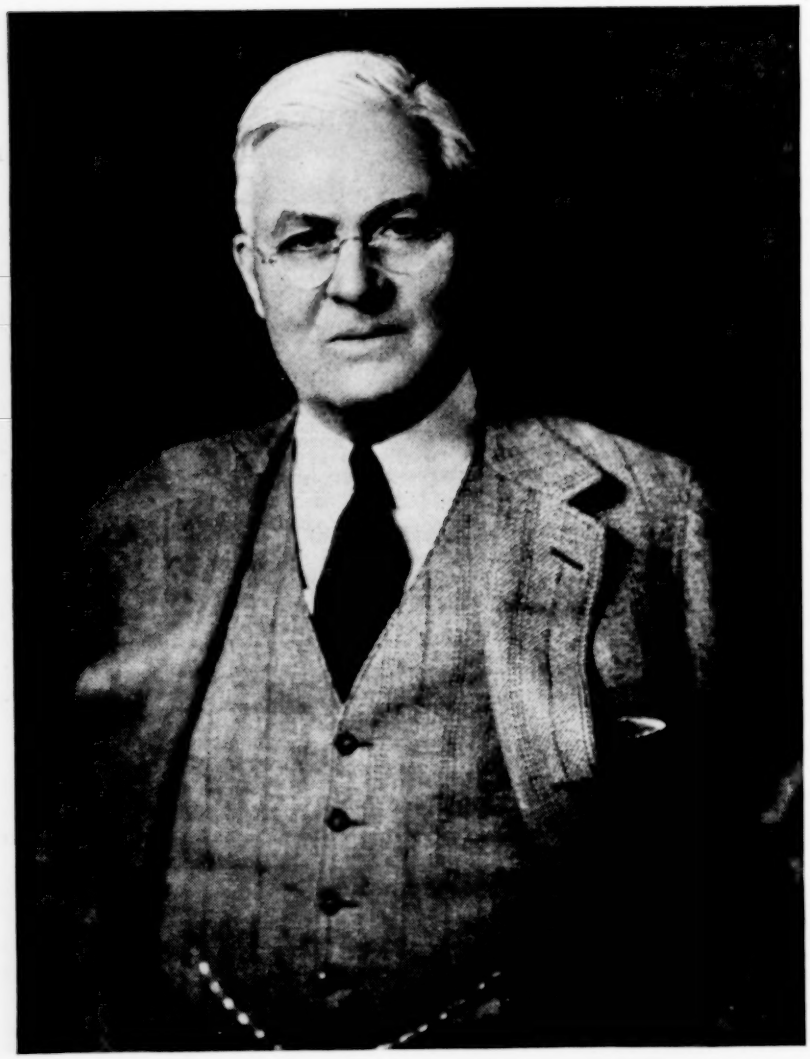

GEORGE WASHINGTON CRILE, M. D.
1864 - 1943

George W. Crile, M. D.

"Great truths are portions of the soul of man;
Great souls are portions of eternity."
—James Russell Lowell[1]

The passing of Doctor Crile—it seems unfitting to use the word death in connection with one who was the personification of aliveness and dynamic energy—takes from the world a valued leader. A leader whose scientific work, surgical skill and altruistic spirit had ramifications into many different divisions of the profession he so long and well served. To each and all such groups his enthusiastic spirit was a stimulus to better effort; his sustaining friendship strengthened the fibre of organizational life.

The American Association of Nurse Anesthetists belongs within the circle of his influence and into its soul has passed some portion of his greatness. Those of us familiar with the early struggle and often, seemingly, insurmountable difficulties which beset the establishment of what is now a recognized and valued type of hospital service, realize with increasing appreciation the constructive part played by Doctor Crile, in efforts to obtain the professional recognition—now happily accorded our group. As Surgeon-in-Chief of a great University hospital Doctor Crile not only initiated nurse anesthetist service there; but also extended his staunch support to the development of a post-graduate school of anesthesiology inaugurated, at a later date, by the trustees of that same hospital. From this center of instruction nurse anesthetist service extended throughout the country. This gift of unswerving loyalty and staunch support will be held "in perpetuum" of grateful remembrance, by our association.

In wider service Doctor Crile was a skilful surgeon, an indefatigable worker and a tireless investigator. Those of us who had the privilege of serving on his staff will always think with admiring affection of our "Chief." As his pupils—and we were all that—we will remember how much he taught us, in regard to gentleness and precision in the application of surgical procedures to the patient. We will not easily forget how by precept and example he made important to us undeviating allegiance and devotion to the advancement of the profesison we, in our several places, served. We will like to remember that while his research in, and work for, medical science brought him many honors, he was always eager to share the credit of his achievements with those who assisted him. That while, like all great leaders, he was possessed of a deep ambition to press forward, he was equally concerned for the advancement of those who were associated with him. It may be truly said—No member of his staff could go too far or reach too high, in their career, to suit the "Chief."

We will value as an example his remarkable self-discipline, and remember with admiration how he bore disappointment with cheerful equanimity and that he met catastrophe with fortitude.

[1] James Russell Lowell. Sonnet VI

We will think with a wave of affection of the charm of his presence; of his warm-hearted, generous disposition. We will recall with delight his sense of humor and how his merry quip eased off many a tense moment of strain. We will remember he was tolerant in judgment, and loyal to his friends; that he had the devotion of his staff, and was beloved and trusted by his patients. Those who loved him—and they are many—rejoice that he had a full and rich life; that he lived it with a deep sense of appreciation, a joyous energy of spirit—regarding each day as an adventure, a challenge for greater effort toward finer achievement.

If one were asked to name Doctor Crile's outstanding characteristics, the answer, I think, would be—intense intellectual curiosity, enthusiasm, indomitable courage, and an immense capacity for work. It can also be said of him what was written of another teacher, some thousand years ago; that he had "unchangeable resolution in the things he had determined to do after due deliberation * * * *; a love of labor and perseverance and a readiness to listen to those who had anything to propose for the common weal."[2]

These qualities of mind and heart, possessed by Doctor Crile, were exemplified in the fact, that over and above his usual arduous labors, he carried forward with absorbing enthusiasm, scientific investigations, concerned with adding to the sum total of human knowledge on that most baffling of problems—the origin of living energy, as manifested in the creative genesis and evolution of man. It was his dream that the accumulation of such knowledge would eventually—by intensive study of acquired data—lead to evolvement of methods whereby the suffering of humanity would be better understood, more intelligently dealt with, and progressively lessened.

"There will come a time, when it shall be light; and when man shall awaken from his lofty dreams, and find his dreams still there, and that nothing has gone save his sleep."[3] Thus by that alchemy of remembrance will the qualities of a great man be transmuted into portions of Eternity.

Let it be recorded that his memory will be held in grateful and affectionate remembrance by those who served with him and loved him.

AGATHA HODGINS
Chatham-on-Cape Cod
January 1943

It is with deep sorrow we report the passing of Dr. George Crile.

For many history-making years he was affectionately known to all his associates as "The Chief." His personal interest in individuals as well as his progressive far-sighted recognition of the need for better care of patients was responsible for many important innovations in surgery. It is to this visionary spirit that the Nurse Anesthetist Association today owes its existence.

Thirty years ago Dr. Crile, one morning while making rounds greeted Miss Agatha Hodgins by saying, "I am going to make an anesthetist out of you. Come and have a talk with me." As a result of that talk, Dr. Crile's quick action, unceasing encouragement and guidance, the nurse anesthetist for

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[2] Meditations of Marcus Aurelius Antoninus—Long translation
[3] "In the Bright Lexicon of Youth." Thomas Bird Mosher

the first time became a vital part of the operating team. This successful experiment was the foundation for the School of Anesthesia at Lakeside Hospital.

Dr. Crile has always been our most generous sponsor, urging us forward to better achievements. He has repeatedly said, "I am very proud of the part I have had in the advancement of anesthesia and the nurse anesthetist and their Schools of Anesthesia. I feel it is one of my best contributions to modern surgery."

Dr. Crile was a great surgeon, but to thousands who worked *with* him and not *for* him he will be remembered for his magnetic and dynamic personality. He placed his faith in our work years ago. Now, for the years to come let us prove worthy of that trust. Let our motto be: "For Better Anesthesia." May the indomitable spirit of "The Chief" be our guide!

LOU E. ADAMS,
Chief Anesthetist,
Cleveland Clinic Hospital, Cleveland, O.

Immediately upon his appointment as Chief of Staff at Lakeside Hospital, Dr. Crile selected a group of assistants who he felt would be capable and intelligent in the organization of a surgical service worthy of the hospital and sensitive to his ideals of the care of the patient. He imbued in them his enthusiasm for the newly suggested principles of combating shock, the proper handling of tissues and the safeguarding measures of anesthesia adapted to the patient rather than to the surgeon.

His teaching was of a positive character and he demanded a strict adherence to duty, and got it. All members of the organization knew they were receiving the benefit of an experience and a knowledge which bespoke success. He accepted no excuses and made none, errors in judgment occurred but the responsibility was placed squarely where it belonged and they were not repeated. The spirit, the morale was high. Each played his best game all the time.

Perhaps the greatest factor of success in the staff organization aside from the dominating personality of the Chief himself, was its continuity. Year by year new members were added, others departing for other work, but always a sufficient number remaining to aid in the schooling of the newcomers in the ideals and principles of the master teacher and organizer.

FRANK S. GIBSON, M.D.,
University Hospitals of Cleveland

ANESTHESIA IN RELATION TO NEUROSURGERY

ERNEST SACHS, M.D.

Professor of Neurosurgery, Washington University School of Medicine, St. Louis, Mo.

Read at the tenth annual meeting of the American Association of Nurse Anesthetists, held in St. Louis, Mo. October 12-15, 1942.

The reason that neurosurgical cases present a special problem in anesthesia is because in the most common neurosurgical conditions that we have to deal with we are constantly faced with the problem of increased intracranial pressure, and whenever there is increased intracranial pressure, there is either threatened or possibly present or partially present an involvement of the medulla and consequently a partial involvement of the respiratory center. The vast number of cases in a neurosurgical clinic are brain tumor and they constitute a very special problem.

From the very earliest days of brain surgery it was realized that these cases presented a special problem, and surgeons made use of different types of anesthetics in the hope of overcoming or at least safeguarding the patient as far as possible against the danger of increased intracranial pressure and its effect on the respiratory center.

In this country, at the beginning of this century, the method of anesthesia that was ordinarily used was ether on an open mask—the drop method. At about the same time in England chloroform was being used. It was soon realized by the English anesthetists that chloroform, if it were to be administered with any degree of safety in an intracranial operation, must be administered by some method other than with the old-fashioned open mask. One of the English anesthetists by the name of Vernon Harcourt invented a very simple apparatus by which he could give chloroform in percentages. A small flask containing chloroform was fastened on one side of a T-tube, and the other side of the T-tube was exposed to the air, and between the two, going into the T, was a valve which could be switched back and forth, so that the percentage of chloroform could be estimated to a fairly accurate degree.

Of course, the objection to chloroform is its harmful effect on the liver, especially in a very long operation. In the early days of neurosurgery, the thing that surgeons attempted to do was to work as rapidly as possible and they disregarded everything else, particularly hemorrhage. Today we realize that it is much better and much safer to carry these operations out very carefully and deliberately, consequently many of these operations are quite long and tedious. It is not at all unusual for a brain tumor operation to last two and a half to three hours and sometimes considerably longer.

To give any patient chloroform for that length of time is obviously out of the question, so that chloroform has been given up in this country many years ago and in order to try to get around the objectionable features of ether on an open mask, an apparatus was devised by Connell to give ether by percentage, which apparatus we used for a number of years and it was fairly satisfactory. The ether was heated and it was given by percentage, but the objection to ether anesthesia always has been, in brain cases, that it tends to increase intracranial pressure so that the dan-

ger that we are contending with from the initial disease is aggravated by the anesthetic itself.

This was somewhat obviated by using the Connell machine which gave percentage ether, but even so it never was entirely satisfactory, although we used it for quite a number of years. I think the machine was invented about 1910 or 1911 and we used it from that time until 1916 or 1917. During the first World War, as a result of the work that was done in the British Army hospitals, we switched to local anesthesia and for a period of about fifteen years all brain operations, and all craniotomies for tumor, were done under local anesthesia.

This was a pretty trying period for both the surgeons and the patients, for though one can do any cranial operation under local anesthesia, it is bound to be slower because one has to be even more careful than usual not to hurt the patient. It was a terrific ordeal for a patient to go through, to lie on a table for three, four, or sometimes five hours under local anesthesia and in addition to be obliged to hear the language of the surgeon, which wasn't always academic. These operations were trying and I can recall a number of patients who came back for secondary operations and the one thing that they requested was, "Can't you put me to sleep? I don't mind being operated again but can't you put me to sleep?" They dreaded that long ordeal.

In order to carry through a local anesthesia successfully in a long cranial operation, it was necessary to give (in small doses, it is true) the one drug that is contraindicated in cases in which there is increased intracranial pressure, and that is morphine. Morphine is the one drug that should be avoided as far as possible except in minute doses, as it affects the respiration, which in many cases of brain tumor is already jeopardized.

What we used to do in those days and what we occasionally do today in an operation under local anesthesia is to give the patient 1/8 grain of morphine, that is, for an adult. It is such a small dose of morphine that all it does is to quiet the patient and there is no danger of producing a harmful slowing effect on the respiration as happens with a large dose of morphine. Then usually toward the end of the operation or after a couple of hours we were obliged to repeat this dose and sometimes even a third time for the actual closure of the skin, since the local anesthesia had lost its effect. This is better than using more of the local anesthetic. That method worked very well, but the objection was that the operations were greatly prolonged and the patient sometimes complained considerably and if, as happens not infrequently, secondary operations had to be done, that was the one thing that the patient always dreaded.

We all, therefore, welcomed the discovery of avertin, and today in most neurosurgical clinics it is the anesthetic of choice and the one that is practically universally used. I know a few neurosurgical clinics where they say that for some reason they cannot use it; they do not seem to be able to keep the patients quiet. My anesthetist, Miss Lindsey, has given between two and three thousand avertin anesthesias for tumor and we very rarely have any difficulty in getting the patient quiet, but there are a number of important tricks about using avertin in cases of intracranial tumor.

In the first place, it is very important to give the avertin fresh—not to let it stand even ten minutes after it is made up. That is enough to spoil the avertin so that it does not work effectively. Another thing that is very important is that the avertin

must be administered with the patient absolutely quiet and undisturbed. It is a great mistake to have an anesthetist with a number of assistants or students standing around when avertin is given. It disturbs the patient and interferes with the effective administration of the avertin. The patient must be undisturbed.

Another point that I think is very important is that the patient should not know what anesthetic he is to be given. Patients often ask me, "I hope I don't have to take ether. Do I?" I say, "No, we don't use ether," but that is all I do say. I do not tell them that they are going to have a rectal anesthetic and I think that is an important point because it helps to keep the patient quiet and in a good frame of mind.

Another point of great importance is the proper dosage. We use larger doses of avertin in children and young people than we do in adults. Whereas the average adult dose is 85 milligrams per kilogram of body weight, except in very fat individuals where the dose has to be somewhat smaller, in children we find that we get the best results if we give them 95 milligrams per kilogram. There are some clinics in which they give as much as 100 or 105 milligrams per kilogram of body weight but we feel that that is getting pretty close to the danger point. We find that 95 milligrams as a maximum dose in children is ample and then at times we give them a few drops of ether on an open mask, which is enough to quiet them until the local anesthetic has been injected.

We do not believe in giving any preliminary drug. I know clinics in which they give one or two doses of nembutal or luminal or one of the other barbiturates as a preliminary before the avertin is given and then, on top of that, give some morphine. That is not giving or using a basal anesthetic, to my way of thinking, and it adds complications which may very seriously disturb one in the course of operation.

We have also found that in summer, in hot weather, we have to use more avertin than we do in winter and we usually give from 5 to 10 more milligrams per kilogram of body weight in summer than we do in winter.

Of course we always use local anesthesia in addition,—1/2 per cent novocaine with 6 drops of adrenalin per ounce added. With that combination we find that we can carry our patients through a very long procedure without any difficulty and rarely have to give them anything in addition. Once in a while a patient apparently has an idiosyncrasy to avertin and is restless, and in that case we may have to give a few drops of ether on an open mask, but it is very unusual over a period of a number of hours to have to use more at most than a half or a quarter of a can of ether.

In addition to making the avertin effective or making the anesthesia smooth and safe, it is routine in my clinic to start intravenous glucose as soon as a patient comes into the operating room. We consider that absolutely essential. I was very much surprised to hear only last week that in one clinic in this country, (not a neurosurgical clinic) the head of the surgical department does not permit the use of intravenous fluids because he once saw a death. I have never seen a death from giving intravenous fluids and I am so convinced of its importance that it has been routine in all our cases. Five per cent glucose, intravenously, is started as soon as the patient is put on the table. It is run slowly, about thirty drops a minute, until a point in the operation is reached where for one reason or another we want to get more fluid into the patient.

It is important in a brain tumor case, where there is increased intracranial pressure, not to do anything to increase the intracranial pressure, and if intravenous glucose is given too rapidly the intracranial pressure will be increased so that by the time the skull is opened, the brain will be so tight that it may be impossible to open the dura safely. The pressure must be reduced before the dura can be opened; for that reason we always start the fluid very slowly,—thirty drops a minute. Then with the first evidence that the patient is going into shock, by merely turning a little stopcock we increase the rate of flow to sixty drops a minute or even a little faster, but usually sixty drops a minute is enough.

The first warning of trouble is not a change in blood pressure but an increase in pulse rate. That is one of the things that I find it is very difficult for people to learn. When a patient begins to have a drop of blood pressure, the trouble is there; the point is to recognize a change before that. The first evidence that the patient is not standing the procedure as well as you would like is an elevation of the pulse rate, and there is an elevation of the pulse rate long before there is any drop of blood pressure. We have the pulse and blood pressure taken every five or ten minutes and recorded on a blackboard on the wall of the operating room. In addition to giving the operator a picture of what is going on it is very useful for teaching purposes and students may thus follow the changes readily. As soon as the pulse rate begins to go up, it is best to increase the rate of flow of the intravenous fluid and it is quite usual for the average adult patient to receive anywhere from 800 to 1000 cc. of glucose intravenously in the course of a major operation.

Then, too, since the needle is in the vein, it is easy to switch from glucose to blood transfusion by merely changing the bottle. Never hesitate to use blood transfusions. I can recall vividly the time years ago when the problem of giving a blood transfusion was a very complicated one. When we first gave transfusions we used a tube (the Kimpton Tube), the inside of which was coated with melted wax so that the blood would not clot. That was before the discovery of citrate blood. I can recall cases in which we lost the patient because of the delay in giving blood. Today we do not hesitate a minute. When the blood pressure begins to drop, we give a transfusion immediately. There is a patient now walking around in very good condition who is going home tomorrow, the twelfth day after an extensive craniotomy. He had four transfusions, —three on the table and another 500 cc. that afternoon. That is an unusually large number of transfusions but it was an unusually large vascular tumor. It so happened that we had two patients two days in succession, both of whom had numerous transfusions. Usually one or possibly two transfusions is all that is necessary, but the important point is not to hesitate to give the blood and to give plenty of it.

We have not used plasma because we have a blood bank and I have had no experience with plasma and its effectiveness compared to blood. Reports in the literature indicate that plasma is almost as effective as blood, but in cranial cases I do not believe it is quite as good, so that if you have the blood available, it is better to give that rather than the plasma. In war hospitals it will be necessary to use plasma, and in the vast number of cases, judging by the accounts coming to us from England and Russia, it is practically as effective. But in civil life, I prefer to give patients blood in operations for tumor.

I have covered briefly some of the principal points I wanted to bring out in the treatment of neurosurgical cases. In other neurosurgical conditions than brain tumors, the problem of giving anesthesia differs little from the rules followed in general surgical cases.

There are just two more conditions I should like to mention before closing. First, the matter of anesthesia for small infants in cases of hydrocephalus and cases of spina bifida, but especially in hydrocephalus where a fairly extensive craniotomy is necessary. The very important thing is to retain the body heat in these infants, and we use a very simple device. I think it is just as good as any of the complicated ones that are on the market. We put the baby on a heated table. We simply use one of the big instrument trays, turn it upside down, put hot water bags under it and a blanket over it, and that works just as well as any of the complicated devices that have been invented.

It has been a striking thing to us also that these infants must be given fluids. In every case of spina bifida and hydrocephalus, fluid is given before operation. In these small infants it is more practical to give Ringer's solution subcutaneously rather than intravenous fluid, but the all-important thing is to see that they have plenty of fluid. In an infant a week old we give 100 cc. of fluid under the skin before we start the operation.

There is one other group of cases that is of considerable interest and offers quite a problem—cases of trigeminal neuralgia or tic douloureux. Some people prefer to do this operation under local anesthesia, but it is the one operation that I will not do under local anesthesia any more. In years gone by I have done it but it is a loathsome thing to do under a local anesthesia, in my experience, because if a patient with trigeminal neuralgia gets an attack on the table while the temporal lobe is being lifted up, it may be disastrous. When the ganglion is manipulated in order to cut the posterior root, there is great likelihood, under local anesthesia, that it will start an attack of pain and those of you who are familiar with how severe the pains of trigeminal neuralgia may be, will readily understand that such a patient could make a sudden turn of the head which might do irreparable harm.

For the above reason, I always operate for trigeminal neuralgia under avertin. The one operation that we do with the patient sitting up is the operation for trigeminal neuralgia. When a patient is sitting up under avertin anesthesia, he runs a much greater risk of having an alarming fall of blood pressure, so we have the patient in the sitting position, all prepared before we start operating. If the patient has a drop of blood pressure which is at all disturbing, we either cancel the operation or wait until the patient becomes adjusted so that it is safe to go on.

Then, too, of course it is a well-known fact that whenever a big sensory nerve is divided,—for instance, in amputation of the leg—it is wise first to anesthetize the nerve with novocaine before cutting it. In amputation of the thigh, the surgeon should always put novocaine into the sciatic nerve before cutting it, because if he does not, the patient may have a terrific fall of blood pressure and collapse.

The same thing is true in an operation for trigeminal neuralgia carried out under avertin and local anesthesia. Before cutting the posterior root of the fifth nerve, we always inject a little novocaine into the posterior root and this makes all the difference in the world and avoids an alarming fall

of blood pressure. It is very unusual in my experience to have any trouble with fall of blood pressure in sectioning the posterior root if this procedure is followed; but if the cutting is done without it, there may be no end of trouble. I have seen it happen with a patient who was not well anesthetized and the blood pressure dropped to zero and the operation had to be stopped and the patient put into the horizontal position.

ENDOTRACHEAL ANESTHESIA IN THORACIC SURGERY

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Read at the tenth annual meeting of the American Association of Nurse Anesthetists, held in St. Louis, Mo., October 12-15, 1942.

I wish to stress primarily the value of endotracheal anesthesia in major thoracic surgery; that is, in thoracic surgery which requires a wide opening in the chest wall for the exposure and removal of either portions of the lung as in a lobectomy or of a whole lung as in pneumonectomy. I want to impress the necessity for endotracheal anesthesia rather than to dwell on the technique of it. It is necessary primarily for two reasons: First, to provide positive pressure anesthesia and second, to provide an easy and rapid method of suctioning the bronchial tree, which has to be done at frequent intervals during such surgery.

Some anesthetists have used a type of intratracheal tube which will go down one bronchus, thereby closing off and eliminating the other diseased lung from the oxygen and anesthesia circuit.[1] They believe that by so doing they can decrease the amount of secretions spilled into the tracheobronchial tree. This has been attempted at Barnes Hospital but given up as being unnecessary, not wholly desirable, and technically too complicated a procedure to be practical. Unless one has a completely water-tight and air-tight block of the bronchus to the diseased lung, such an arrangement does more harm than good. We have been able to get along very well with an ordinary intratracheal tube, the distal end of which lies in the trachea instead of in a single bronchus. A large calibre semi-rigid tube is used which will permit the easy introduction of a catheter for aspiration.

As the anesthetic agent we are accustomed to use cyclopropane. A small amount of ether is administered at the beginning in preparation for the insertion of the intratracheal tube. A small amount of ether is also used at the end of the anesthesia in case an aspiration bronchoscopy seems necessary at that time.

A non-inflammable anesthetic agent is necessary for a cautery pneumonotomy drainage of a lung abscess. For this we use nitrous oxide as the basic anesthesia, supplemented by intravenous sodium pentothal. In that way, neither type of anesthetic needs to be forced to its extreme limit. The patient is maintained at a relatively light level of anesthesia so that the cough reflex is not abolished, and with it his ability to expel the large amounts of secretion from the bron-

chial tree. The patient is also kept in a 45° Fowler's position so that the secretions will tend to drain out through the newly opened bronchopleural fistula rather than come up into the trachea.

Let us come back to endotracheal anesthesia and the necessity for having positive pressure available, whether or not it is used at all times. One must first appreciate the mechanism of respiration and primarily the fact that the lung is an elastic organ which is not adherent, under ordinary circumstances, to the chest wall. In order for the lung to follow the excursions of the chest wall and the diaphragm in inspiration, a negative pressure must be maintained in that potential space beween the lung and the chest wall. If that negative pressure is lost, the lung immediately collapses to about a third of its original volume. A negative intrapleural pressure of between five and ten millimeters of mercury is ordinarily present during the height of inspiration. A small amount of negative pressure is also present throughout expiration.

When a large opening is made in the chest wall, the lung immediately collapses. This would seem at first to be all right, because if one intends to remove a diseased lung, no harm should come from collapsing it prior to removal. The patient should be able to breathe adequately with only one lung before the other is removed. That would at first seem feasible, considering the two lungs as separate organs divided by the mediastinum. The mediastinum, however, is not a rigid partition. It is flexible, and transmits any change in intrapleural pressure present on one side to the other side, so that as soon as the chest wall is opened the lung on that side collapses and the lung on the opposite side partially collapses. You can see that it would be impossible for the patient to continue to carry on the respiratory function during such a state of pulmonary collapse. It is, therefore, necessary to introduce some method of maintaining positive intrabronchial pressure to substitute for the lost negative intrapleural pressure. The most satisfactory method is by means of an intratracheal tube connected to a closed anesthesia system.

One of the most difficult periods during a major thoracic procedure is when the chest wall is first opened. At that time a sudden rush of air enters the thoracic cage and collapses the lung unless sufficient positive pressure has been applied to the tracheobronchial tree prior to the opening of the chest wall. When the lung on that side suddenly collapses in the absence of positive intrabronchial pressure, the patient begins violent respiratory excursions in an attempt to compensate for the lost pulmonary volume. Sometimes these excursions are so violent that the lung is actually blown right out through the opening in the chest wall and is found lying outside the rib cage, still connected by the hilum.

In other cases, the respirations cease completely due to the sudden change of intrapleural pressure. In that case, the chest wall must be immediately closed and artificial respiration supplied either by the anesthetist or by the surgeon in order to reinitiate the respiratory cycle. That can, of course, be done; but it does create a somewhat irregular anesthesia and frequently requires the remainder of the operation to get the patient's respirations adjusted again.

We do not use controlled respiration in its fullest sense. We do, however, control the respiration by means of the carbon dioxide absorption apparatus, so that the lung and diaphragm are not moving too violently to permit the manipulation by the surgeon. We do not insist on ab-

solute quiet of the lung while working on it, but do appreciate a "quiet anesthesia."

Another time when the intratracheal positive pressure anesthesia is greatly appreciated is when the chest wall is to be closed. Ordinarily during the course of the anesthesia, a positive pressure of three to five millimeters of mercury seems sufficient to maintain enough expansion of the lung to permit normal respirations. When the time comes to close the lung, particularly after only a portion of the lung has been removed as in lobectomy, one would like to reinflate the remaining portion of that lung. In order to do that, the anesthetist applies a little more positive pressure, up to ten millimeters of mercury. This has been found to be sufficient to inflate almost any lung and represents a safe maximum pressure.

In that way, the upper lobe partially fills up the space which has been left by the removal of the lower lobe. Unless the remaining lung tissue is thus reinflated before closing, a thoracentesis needle must be introduced and the excess air removed by suction. If the excess air is not removed, the patient will usually develop considerable subcutaneous emphysema. As the patient coughs during the day following the operation, he will blow the excess air out into the subcutaneous tissue, and become all puffed up like a balloon, so that he will not be able to open his mouth or his eyes. This will probably cause his relatives considerably more distress than it will cause the patient.

Another time at which the anesthetist is able to help a great deal is in determining just how much lung is being removed. Before the removal of the lung and before the bronchus is transected, the surgeon clamps the bronchus in the proposed area of transection and the anesthetist supplies a little bit more positive pressure to see whether the portions of lung to be left will still inflate. The bronchi cannot always be exposed quite as well as one would wish for, so that in attempting to remove a lower lobe, for instance, one might very readily get the clamp across the middle lobe bronchus also and after once transecting the bronchus, the middle lobe would have to be sacrificed, unless it had been previously tested.

There are certain dangers in positive pressure anesthesia which are not as frequently encountered at present as they were during the early days of endotracheal anesthesia.[1] At the beginning of the last decade, when insufflation anesthesia was the rule, it was more difficult to determine exactly how much pressure was being applied, and the intrabronchial pressure sometimes rose suddenly due to an obstruction of the escaping gas around the catheter.

At present we have much more satisfactory means of measuring and controlling the amount of positive pressure so that the complications are less frequent. The most usual complication is the rupture of an alveolus with escape of the air into the mediastinum. Dr. Macklin[2] has shown that the air follows the perivascular sheaths from the lungs over into the mediastinum. This is not always fatal but it does embarrass the cardiorespiratory system by the compression of the large vessels. A tension pneumothorax can also occur in a similar manner with or without associated mediastinal emphysema.

Dr. Macklin[2] has carried out a number of experiments on that problem in animals and has shown that as little as twenty millimeters of mercury in a cat and twenty-four millimeters in a dog is sufficient to rupture an alveolus. One case of mediastinal emphysema and pneumothorax was pub-

lished by Keidrick, Adams, and Livingston[3] in 1939 following the use of a positive intrabronchial pressure of twelve millimeters of mercury in a human being. It is somewhat rare to have a pneumothorax and mediastinal emphysema resulting from as low a pressure as twelve millimeters of mercury, but it can happen.

A safety valve is used on the anesthesia machine at Barnes Hospital which does not permit a positive pressure of over ten millimeters of mercury at any time. Ordinarily that much is not necessary and we can get along with four to five millimeters or even less during the major portion of the procedure.

A second complication of positive pressure anesthesia is a compression of the great vessels in the thorax by the pressure, which is transmitted throughout the whole thoracic cage. With the compression of these vessels, there is a decrease of the return of blood to the heart and a consequent drop in blood pressure. The extent of that drop was also worked out experimentally by Dr. Macklin[2] to represent six to eight millimeters of mercury in blood pressure for each ten millimeters of mercury rise in the intrabronchial pressure. Ordinarily that would not create a sufficient decrease in blood pressure to be fatal.

Another reason for a decrease in blood pressure is the pleural reflexes. Frequently when tension is applied to the lungs with the visceral pleura intact, the blood pressure drops immediately. This drop in blood pressure can be immediately remedied by releasing the tension on the lung, and it is the duty of the anesthetist to recognize the drop in blood pressure immediately and notify the surgeon.

The second primary reason for having an intratracheal tube in place during major thoracic procedures is the necessity for frequent suctioning of the tracheobronchial tree. As you know, in cases of diseased pulmonary tissue, particularly lung abscesses or bronchiectasis, large amounts of purulent material are present, ranging as high as 1000 or 1200 cc. of pus a day, if carefully measured. A bronchogenic carcinoma produces lung abscesses behind the point of the obstruction or bronchiectasis in the case of some of the slower growing tumors. This problem of excess bronchial secretions and copius amounts of pus is present in almost all types of major thoracic surgery, and one can readily appreciate what happens when a large quantity of pus is discharged into the bronchial tree at one time without adequate suction apparatus available.

Certain methods of combating this type of asphyxia are available before the operation is started. The patient should be kept up on a tilt table for postural drainage for a half hour immediately preceding the operation. In that way he may be able to get rid of a considerable amount of this pus. In case large amounts of pus are suspected, particularly in bilateral bronchiectasis, a bronchoscopic aspiration should precede the major operation. Even after that, enough pus will remain to require suctioning at frequent intervals, particularly immediately after the chest wall is opened. The lung is bound to collapse to a certain extent when the chest wall is opened. As it collapses, it squeezes out large amounts of pus into the bronchial tree. This should be immediately aspirated before it spills over into the healthy opposite lung and causes either an immediate asphyxia or a late aspiration pneumonia.

A second occasion at which one is most apt to encounter large quantities of pus is when the lung is being deflated manually preparatory to its removal. This is particularly true when lobe forceps have been applied to the

diseased lung tissue, squeezing out large amounts of pus.

Endotracheal anesthesia thus seems necessary in major thoracic sugery to provide a positive pressure anesthesia and an adequate airway for suctioning the bronchial tree.

1. *Gillespie, Noel A.*: Endotracheal Anesthesia. University of Wisconsin Press, 1941.
2. *Macklin, C. C.*: Pneumothorax with Massive Collapse from Experimental Over-Inflation of Lung Substance. Canadian M. A. J. 36:414, 1937.
3. *Heidrick, A. F., Adams, W. E.*, and *Livingston, H. M.*: Spontaneous Pneumothorax Following Positive Pressure Intratracheal Anesthesia. Arch. of Surgery 41:61-65, July, 1940.

ANESTHESIA IN PERORAL ENDOSCOPY AND LARYNGEAL SURGERY

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The versatile anesthetist of today does not limit herself to the use of a few drops of ether or chloroform. She has at her disposal a far greater range of anesthetic agents and methods of administration than she had a few years ago. Realizing this, I deem it needless to tell you what anesthetic to employ in peroral endoscopy or laryngeal surgery. Rather, it should be my purpose in presenting this paper, to discuss with you a few of the problems encountered in this type of anesthesia. Because the individual requirements of no two patients are the same, and because each surgeon has his own particular technique, these factors are continually changing. It is through meetings like these, where we may exchange ideas and experiences, that we can better prepare ourselves to meet new situations as they arise.

Let us consider first one thing that cannot be overemphasized, namely, the preoperative preparation of the patient. By this I mean not only the premedication, but also the psychological preparation, for the patient often dreads the thought of having an anesthetic far more than the surgical procedure itself. I feel that I am fortunate in the arrangement of my work, which permits me to be in the office in the afternoons, because it is possible at that time to make friends with the children, and to gain the confidence of the adults before either is admitted to the hospital. Upon his arrival in the operating room, the patient then feels that he is being met by a friend instead of a total stranger, and his dread is lessened considerably. It is wise to be confident and calm and speak in modulated tones, for while under an anesthetic noises are amplified, and the sense of hearing is the last to be abolished.

Premedication based upon the requirements of the individual is given at least an hour before operation. The patient is entitled to the benefit of any harmless drug which will make the ordeal of an anesthesia less terrifying, but it should be given long enough ahead of time to produce the desired effects.[1] A narcotic may re-

lieve pain in thirty minutes, but the desired sedative relaxing effects usually do not reach a maximum in less than an hour.

Parents often err by telling their child some such story as that he is going to "have a picture taken." It has been proved time after time, by the conduct of the child on the table, that the knowledge of just what is to take place is much more effective. Ordinarily, a child needs no premedication. He is admitted to the hospital on the morning of operation, and is taken to surgery before he has become apprehensive. If the anesthetist can engage him in a conversation, and at the same time direct a flow of pure nitrous oxide across his face, he will become drowsy and fall asleep without the excitement experienced by having the mask pressed tightly to his face at first. True, there is some waste of the anesthetic agent with this technique, but it is worth the greater comfort experienced by all concerned. A pleasant induction is greatly desired, because of the fact that the child may need to have another anesthesia at some future date. In cases of multiple papilloma of the larynx, where recurrence is not uncommon and it is necessary to repeat the removal of these growths, an anesthetic may have to be given at frequent intervals. We have on record one such case in which the child was given over one hundred general anesthetics.

Peroral endoscopy is performed for purposes of therapy, for diagnostic examination including biopsy, and for the removal of foreign bodies from the food and air passages. Unless the patient desires a general anesthetic, or is uncooperative, a local anesthetic is quite satisfactory for all but the removal of foreign bodies. For this we feel that a general anesthetic is preferable; first, because it permits the surgeon to enter the lungs without producing trauma to the larynx or tracheobronchial tree, and secondly, it minimizes the possibility of producing a tear in the esophageal mucosa. Some specialists remove foreign bodies from the air passages under local anesthesia, but they often report the necessity of tracheotomy following the procedure. These tracheotomies are performed to relieve the dyspnea which follows traumatization of the larynx and trachea. With the patient relaxed under a general anesthetic, the chances of producing trauma are reduced to a minimum, and no dyspnea follows the bronchoscopy. In the past several years we have had to perform only one tracheotomy following the removal of a foreign body from the lung, and I should like to cite this case.

A boy, age eleven years, had aspirated a discharged .22 cartridge. An x-ray had been taken which showed the cartridge to be in the right bronchus. Bronchoscopy had been performed under local, or perhaps vocal anesthesia, but no foreign body was found. The child was admitted to our service that evening, and under general anesthesia, the larynx, trachea, and right bronchus were found to be quite severely injured. Examination of the left bronchus revealed the cartridge, and it was easily removed. Evidently the child had had a coughing spell after the x-ray was made, and had dislodged the cartridge from the right to the left bronchus, which was not visualized in the previous bronchoscopy. The next morning the child was dyspneic, and by noon it was found necessary to perform a tracheotomy. The cannula was removed on the sixth postoperative day, and further recovery was uneventful.

One problem to be met by the anesthetist in peroral endoscopy, is that of the darkened operating room. Respiration may be difficult to observe, but may easily be followed by placing the

hand lightly on the epigastrium just below the xiphisternum[2]. After a few such cases, the anesthetist will be able to detect even the slightest change in respiration as readily as she can follow the pulse. She will then depend less on the other signs of anesthesia, and the darkened room will no longer seem such a hindrance.

Perhaps the most common indications for direct laryngoscopy are the securing of biopsy specimens, and the removal of tumors from the vocal cords. Any one of several anesthetics, including local, ether, avertin, intravenous, or gas-oxygen induction to ether anesthesia may be used. Our preference is for the latter.

The necessity of complete relaxation and quiet respiration is quite evident in such delicate surgery as the removal of tumors and other pathological processes from the vocal cords. To insure a perfect voice following the removal of benign tumors, the surgeon must be able to remove the growth without injuring the cord itself. He depends upon the anesthetist for full cooperation in keeping the patient relaxed, and the anesthesia deep enough to abolish all laryngeal reflexes. In striving for complete induction, one must remember that anesthesia cannot be carried hurriedly to the third stage and maintained there.[3] A definite length of time must elapse to allow for an equilibrium to become established between the anesthetic tension in the face piece of the machine and the anesthetic tension in the body tissues. It is this fact that has been overlooked when the patient starts to retch and cough when the change is made from the closed system to insufflation ether. In obstinate cases, it may be necessary to change to drop ether before insufflation. In most instances, however, a sufficiently high concentration of ether may be built up in the machine and in the lungs and body tissues, to keep the patient from coughing during the transition.

In early carcinoma of the vocal cords, the lesion is removed by intralaryngeal dissection, and the base of the wound is cauterized with the diathermy current. In these cases we use pentothal sodium intravenously, although realizing that by some it has been considered unsafe for laryngeal work. Adriani says that pentothal sodium does not abolish the pharyngeal or laryngeal reflexes[4]. Instead, it tends to produce hyperactivity of these reflexes, and laryngeal spasm may occur on manipulation of the vocal cords. However, if a 4 or 10 per cent solution of cocaine is used as a local application to the pharynx and larynx before the operation is begun, the incidence of laryngeal spasm is greatly reduced. Should spasm occur, the surgeon, having the cords well visualized, can separate them with a spatula, or preferably introduce a small bronchoscope. This will allow oxygen or air to pass through, the spasm will subside, and the operation may be completed.

The necessity of using atropine as a premedicant in pentothal sodium anesthesia for children as well as for adults, is obvious for several reasons:[5] (1) It tends to depress the laryngeal nerve, (2) it decreases the amount of mucus in the throat, (3) tidal exchange and oxygen consumption are increased, and (4) the respiratory rate is also slightly increased.

Among the many advantages of pentothal sodium anesthesia, those of most importance in anesthesia for laryngoscopy are as follows: (1) It is not explosive, (2) the anesthetist may be away from the field of operation, and (3) there are no anesthetic vapors to annoy the surgical team. Local anesthesia also has these qualities, but relaxation is found wanting, especially in patients who are not unusually cooperative. Young and

Pinkerton[6] state that their experience has shown that the chief value of pentothal sodium is to produce unconsciousness along with the necessary muscular relaxation. They indicate that it is inadvisable to omit some degree of local anesthesia.

Our technique of administration is as follows: An infusion of saline solution, or saline and glucose solution is started. All preparations for laryngoscopy and diathermy coagulation are completed, and the patient is draped before the pentothal solution is injected. The rubber tubing about four inches from the needle is sterilized with iodine and then with alcohol, and the needle of the syringe containing the anesthetic is introduced into this area. Two or three cubic centimeters of a 5 per cent solution of pentothal sodium are injected very slowly, and the patient is instructed to count aloud. The anesthetist should pause to observe the effect of this preliminary dose. After a pause of about twenty or thirty seconds, the patient has usually stopped counting, and two cubic centimeters more of the pentothal sodium solution may be injected as slowly as before. Following this injection, except possibly in robust subjects, the jaw will become relaxed and the examination may begin. An increase in respiration with or without straining will indicate the need of further administration of the anesthetic.

A clear airway should be maintained at all times, and the color, pulse, respiration and blood pressure should be watched carefully. Close observation postoperatively is very important because the irritation present may produce laryngo spasm before the patient reacts, or the operative procedure may produce an edema of the glottis or other structures in the throat. Depending upon the amount of swelling produced, it may be necessary to perform a tracheotomy, but this is seldom necessary if the surgeon is skillful in the technique of laryngeal manipulations. Intravenous anesthesia should be avoided in cases of respiratory obstruction, and asthma should be regarded as a definite contraindication.[7]

Intrinsic carcinomas which are too extensive to be removed by intralaryngeal surgery, may be removed by laryngofissure or laryngectomy, depending upon the extent of the lesion. Formerly, these procedures were done in two stages, under general anesthesia: first, a tracheotomy, followed in about ten days by the laryngofissure or laryngectomy. Anesthesia for these cases was comparatively simple, because induction was easy via the tracheotomy tube, and maintenance presented no definite problems. As soon as the surgeon had severed the trachea or split the larynx, he would pack off the trachea just above the tracheotomy tube. This prevented any blood from entering the tracheobronchial tree, and it also prevented the anesthetic mixture from escaping. At present this type of surgery is done in only one stage, and in our cases local infiltration is used almost entirely.

BIBLIOGRAPHY

1. Ross, H. S.: Some Problems of Deep Anesthesia. Southern Med. Jl., Vol. 34, No. 6, page 615. 1941.
2. Young, G., & Pinkerton, H. H.: Pentothal Sod. Anes. in Peroral Endoscopy, Jl. of Laryngology & Otology, Volume LVI, No. 10, page 343.
3. Graham, James: Physiology of Anesthesia. Bulletin of American Ass'n of Nurse Anesthetists, Vol. 8, page 8, 1940.
4. Adriani, John: Pharmacology of Anesthetic Drugs, page 44.
5. Adriani, John: Pharmacology of Anesthetic Drugs, page 34.

6. Young, G., & Pinkerton, H. H.: Pent. Sod. Anes. in Per-Oral Endos. Jl. of Laryng. & Otol. Vol. LVI, No. 10, p. 338.

7. Young, G., & Pinkerton, H. H.: Pent. Sod. Anes. in Per-Oral Endos. Jl. of Laryng.,& Otol. Vol. LVI, No. 10, p. 343.

ANESTHESIA FOR LARYNGECTOMY

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We are presenting thirty cases of total laryngectomy or laryngeal fissure for carcinoma of the larynx, covering a period of six years. There were no deaths in this series.

For five years we had been using avertin, with a dosage of 100 milligrams per kilogram of body weight. This dosage was supplemented in all cases with local infiltration of 1/2 per cent procaine. In four cases it was also necessary to supplement with nitrous oxide and oxygen through a tube into the trachea. These patients were all given morphine, atropine and one of the barbiturates (usually pentobarbital) before operation. The anesthesias went along fairly well but no one was quite satisfied.

In November 1941 we started using a solution of 2 1/2 per cent pentothal sodium intravenously, supplemented with 1/2 per cent procaine. We use the Gilson mixing adaptor and one-way valve, which prevents any possibility of back flow. This is connected with a saline reservoir hung seven feet from the floor to prevent the flow of the anesthetic from stopping the flow of saline.

The operating time of these cases has ranged from one hour and thirty minutes to four hours and thirty minutes. The anesthesia is kept in a very light plane, with the cough reflex present. Oxygen is administered directly into the trachea from the time it is opened, and previously through an oral airway if necessary. Routinely, we give 2 cc. of picrotoxin intravenously as soon as the anesthetic is discontinued.

Out of the thirty cases, two patients contracted bronchopneumonia postoperatively, one with each anesthetic described. Both patients were men forty-five years of age. They recovered quickly and their hospital stay was not prolonged.

There were twenty-eight men in the group and two women. The youngest patient was thirty-nine and the oldest seventy-seven, with an average age of fifty-five years for the group. The average stay of these patients was eighteen days, although several were discharged in six, seven or eight days. In all fairness it must be stated that as far as we know, the change to the newer anesthetic has made no appreciable change in the length of hospitalization.

On the whole, the otolaryngology staff and the anesthetists feel that the change to pentothal sodium intravenously for laryngectomy or laryngofissure has been a decided advantage to the patient and to everyone concerned.

ANESTHESIA IN INTESTINAL OBSTRUCTION

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Read at the tenth annual meeting of the American Association of Nurse Anesthetists, held in St. Louis, Mo., October 12-15, 1942.

What I have to say about anesthesia in intestinal obstruction really applies to a good many other conditions, such as general peritonitis, and in fact to many conditions called acute abdominal emergencies which require operation. The problems, of course, are many.

Before discussing the problems of anesthesia, it might be a good idea to mention two of the most important clinical manifestations of intestinal obstruction. First, these patients exhibit severe systemic changes dealing largely with the integrity of the circulation. In other words, many of these patients are grave anesthetic risks. These systemic manifestations are produced on the one hand by absorption of toxic material from a bowel which has been damaged by the obstruction because of an impairment to its blood supply. I will mention this factor a little later because it sometimes develops suddenly during the course of the anesthesia, after release of a strangulation.

The other factor in producing systemic manifestations is the loss of large amounts of plasma into the wall and peritoneum of the patient with intestinal obstruction or general peritonitis, or even with distension alone. The important part of this factor is that the condition can be relieved by the use of large transfusions of plasma rather than simple injections of saline and glucose. If this is understood by the surgeon and the anesthetist, much of the circulatory and even the respiratory impairment may be corrected before and during anesthesia, thus making the problem of anesthesia easier.

The second group of clinical manifestations produced by intestinal obstruction deals with the local abdominal signs and symptoms, of which abdominal distension presents the greatest problem as far as anesthesia is concerned. This is due not only to the pressure exerted on the diaphragm and therefore on the respiratory apparatus, but also because of the added necessity for deep relaxation during the course of the operative procedure. It is because of this last problem, i. e., relaxation, that many surgeons have turned to spinal anesthesia in intestinal obstruction, but in my experience, in the severe cases at least, this form of anesthesia has more disadvantages than advantages, largely because of the severe systemic manifestations I have already mentioned, i. e., impairment of the general circulation. Because spinal anesthesia really affects the circulation more than an inhalation anesthetic, I prefer general anesthesia by means of one of the gases or by ether, particularly when certain precautions are carried out, which I will now discuss.

During the course of the operation there are at least three phenomena which I am sure you have all observed and which I would like to emphasize as being of particular interest to the anesthetist. The first concerns a most important and often a very delicate subject, which unfortunately is sometimes overlooked until the diagnosis is made at the autopsy table. I refer

to aspiration pneumonia. Patients with intestinal obstruction, with severe abdominal distension from any cause, or in fact, patients who have been vomiting because of any acute abdominal lesion, may aspirate the contents of the intestinal tract during anesthesia. This possibility is made more likely by the necessity of deep anesthesia in order to obtain complete relaxation. Now aspiration can be avoided to a large extent by minimizing distension before operation. In many cases such attempts are made by means of various decompression techniques, particularly by the Miller Abbott tube, which when passed into the duodenum and small intestine, permits removal of intestinal contents, thus eliminating the danger of their aspiration into the lungs during operation.

Unfortunately, these attempts at decompression are not always successful, and often in very good hands it is still necessary in many cases for the surgeon to operate upon a patient whose abdomen is fairly well distended. In patients with intestinal strangulation, moreover, operation is so urgent that time cannot be taken for such preoperative preparation. The danger of aspiration, however, can be minimized to a considerable extent by simple preoperative gastric lavage. Whether the intestine can be intubated or not, at least the stomach can be emptied and indeed the tube may be left in the stomach for drainage immediately before and perhaps often during operation. In many instances, this will undoubtedly prevent or minimize regurgitation of intestinal contents into the esophagus and their aspiration into the lungs. The anesthetist, of course, should have constantly at hand such an apparatus for removal of any material that may be regurgitated. She must realize that while the stomach may be empty before the operation, the operative manipulation and exploration of the abdomen may induce regurgitation into the stomach.

In this connection I think it very important to acquaint the anesthetist very frankly with these problems and the possibilities of aspiration before the operation, so that she may know just what danger there is and be ready to watch for it. Conversely, it is important for the anesthetist to tell the surgeon if there has been any regurgitation and of the likelihood of aspiration, because nowádays, fortunately, because of chemotherapy, aspiration pneumonia is not as serious as it used to be.

If there has been danger of aspiration pneumonia, the early use of the sulfonamides will prevent the aspirated material from gaining a serious foothold. I have recently seen several instances of very mild types of pneumonia rather than the severe fulminating form, due, I am sure, to the prompt use of sulfatherapy.

Of perhaps greater importance in preventing aspiration is the use of intratracheal anesthesia, which I have used more and more during the past few years. This technique removes the danger of aspiration to a great extent, but there is another reason that I prefer it in this case, i. e., it minimizes the danger of anoxia, which is the second problem occurring during the course of anesthesia in patients with intestinal obstruction.

One of the systemic manifestations I mentioned in patients with intestinal obstruction is the circulatory impairment which in turn inevitably leads to anoxia or hypoxia, which is perhaps a better term. These patients may exhibit very little if any cyanosis, but they will be on the border-line of oxygen lack, which will be manifested merely by an increased pulse rate and other signs of a poor circulation. In these very ill patients, one must take it for granted that oxygen

lack is present, because one of the things about anoxia which has been noted both experimentally and clinically is that an ounce of prevention is worth a pound of cure.

The use of a high percentage of oxygen with the anesthetic before signs of oxygen lack develop is probably one of the best ways to combat anoxia. This does not mean that the administration of oxygen will not be effective even when cyanosis has developed. Its effect in these patients is sometimes very dramatic. I have on numerous occasions observed prompt improvement in circulation as shown by lowering of the pulse rate, improvement of the blood pressure, and even improvement in consciousness. Indeed, in many of these very sick patients, so important is the inhalation of 95 per cent oxygen and 5 per cent carbon dioxide that we place a mask over the patient's face at the conclusion of the operation, attaching it to a portable oxygen tank so that he may inhale oxygen all the way from the operating room back to his bed, where an oxygen tent has been prepared. Because of the importance of high concentrations of oxygen, intratracheal anesthesia offers an added advantage in that it permits a higher concentration of oxygen with the anesthetic than does the open method.

The third difficulty which may occur during operation for intestinal obstruction is definite circulatory collapse, which occurs particularly in patients with strangulation either from hernia or in cases of volvulus. Here a large mass of intestine is not only obstructed but its blood supply has been interfered with, resulting in damage to the bowel wall. Absorption from this damaged intestine will produce severe circulatory collapse. The best example of such a sudden phenomenon is a strangulated hernia. The surgeon will expose the hernia and will cut the neck of the sac, and as he does so, damaged bowel becomes connected again with the circulation, toxic products are absorbed and you may suddenly find the patient in shock. I have seen this happen a number of times and it is, of course, most alarming, but fortunately in such an instance, the collapse is really transient, and with the administration of pure oxygen and artificial respiration, if necessary, the manifestations generally disappear within the course of a few minutes.

In closing my remarks, I would like to emphasize again that one of the most important factors in minimizing the risk of anesthesia in intestinal obstruction is a very close cooperation between the anesthetist and the surgeon. If the patient is severely ill, (and many of them are inevitare), I like to discuss the condition of the patient with the anesthetist before the operation, letting her know all of the problems and lesions presented by the patient, and discuss quite frankly the type of anesthesia and the dangers which may occur. I am very glad to be here and tell you about these problems which I hope will be of some help to you. After all, it does not make any difference who does the important things that have to be done. The things to emphasize are intelligent cooperation, excellent preparation for your work and continued research in order to study the problems which still remain unsolved.

OBSTETRICAL ANALGESIA AND ANESTHESIA

FRANCES KOCKLAUNER
University Hospitals of Cleveland

Read at the tenth annual meeting of the American Association of Nurse Anesthetists, held in St. Louis, Mo., October 12-15, 1943.

An editorial in the Medical Journal of Anesthesia some years ago defined a normal labor as one in which uterine contractions act thoroughly and efficiently, leading in a short time to the spontaneous delivery of a healthy baby and causing but little or no distress or suffering to the mother. The author added that this is not attained today because of the present state of civilization and our mode of living. These reasons and the demand of women for painless labor, have led the medical profession to endeavor to find drugs which when skillfully administered will produce satisfactory amnesia without harm to mother or baby.

It is impossible to enumerate the many drugs that have been advocated and used successfully in obstetrics. The best known and probably the most widely used are morphine and scopolamine and the barbituric acid derivatives—sodium amytal, nembutal and seconal.

The anesthetist plays an important part in the successful pre-delivery treatment. If the various medications used are ineffectual or cannot be given in sufficient doses to keep the patient comfortable, it may be necessary for the anesthetist to give gas or ether during contractions if the mother is to have a completely painless labor. In the majority of cases medication will keep the patient comfortable until the beginning of the second stage.

In the Obstetrical Division of the University Hospitals of Cleveland morphine and scopolamine are given to the primipara unless the doctor orders otherwise. Some authorities object to the use of these drugs on the grounds that they frequently prolong labor, delay respirations of the child and have a tendency to produce fetal asphyxia. They also state that the patients have excessive thirst and sometimes intense headache, blurred vision and delirium. Dr. Sollmann says that morphine and scopolamine fail to produce narcosis in one-seventh to one-third of the cases and are uncertain in the whole treatment.

Dr. Arthur Bill, our Chief Obstetrician, believes that morphine and scopolamine, if given properly, produce the most uniformly satisfactory results. He says that this medication does not interfere with the progress of labor, is safe for both mother and infant, and consistently leaves the patient with little or no recollection of the entire labor. The completeness of its action in this respect is not equalled by other medication. In his opinion, if scopolamine causes fetal mortality, it is undoubtedly owing to the manner in which it is used. To avoid serious apnea in babies, he advises strict adherence to the rule that scopolamine not be given within at least three hours of the time of delivery. He believes that the observance of this rule has been responsible to a large extent for the uniformly good results which we have seen. It is seldom difficult to time the administration to conform to this practice. After the first three doses, which are given forty-five minutes apart, 1/400 grain of scopolamine is administered hypodermically every one and a half hours; consequently, one and a half hours having already elapsed, it is

necessary only to estimate whether or not the patient will be ready for delivery before another one and one-half hours shall have elapsed.

Routine Morphine and Scopolamine Dosage:

Morphine, grain 1/6
Scopolamine, grain 1/150
as soon as pains seem to hurt, with no regard for the amount of dilatation.

Scopolamine, grain 1/200
after forty-five minutes.

Scopolamine, grain 1/400
after another forty-five minutes, and every hour and one-half thereafter, until discontinued.

As a rule, morphine is not given again, but if the pains are unusually hard an additional 1/6 grain may be administered.

Sodium amytal, seconal or a combination of sodium amytal and seconal, is given to the multipara unless other medication is ordered. The dose can be administered either by mouth or by rectum. Some authorities (Sollmann, et al), state that labor is not delayed; that circulation, respiration and temperature of the mother remain normal, and that the babies are not notably narcotized and breathe promptly. We have, however, observed that this is not always true insofar as the baby is concerned because some are noticeably narcotized, but we do not believe that we have lost a baby as a result of this procedure. Within a reasonable length of time the baby breathes and is in good condition. We do not observe the three-hour rule with amytal as in the use of scopolamine. Occasionally when labor is prolonged, we administer sodium amytal or seconal or a combination of amytal and seconal following the regular scopolamine and morphine treatment, when the patient approaches the second stage.

The patients in our institution are admitted directly to the delivery suite. The routine preparation following admission is given as indicated—bath, et cetera, and the patient put to bed in a quiet, well ventilated room—the room in which she will remain until she is transferred to the division following delivery. The patient is delivered by merely turning the body sideways on the bed, which eliminates moving the patient from the bed to an operating table. This prevents muscular discomfort postpartum from the use of stirrups. One of the greatest advantages is the absence of circulatory disturbances which may result from transferring a deeply narcotized or anesthetized patient from one position to another.

The anesthetist is an important person on the obstetrical team, but, unfortunately in the less active clinics due to the irregularity of the work, it is impossible to have an anesthetist with the patient during the entire period of analgesia. At Maternity Hospital an anesthetist is on duty at all times and cooperates with the nursing staff in following the progress of labor. Babies have been saved because the anesthetist was available to administer an anesthetic immediately, thus diminishing the force of the contractions, and preventing injury or death to the baby from excessive pressure.

Dr. Bill has consistently maintained that an anesthetist in order to be of the greatest value must know the mechanics of labor and be available to follow up the medication treatment with ether or nitrous oxide and oxygen analgesia when necessary. The anesthetist must be able to feel the contractions before the patient is aware of them, and just enough analgesia should be given to keep the patient comfortable. Too much analgesia, however, may cause the contractions to become less severe and far-

ther apart. Ether if improperly administered has a greater tendency to retard labor than nitrous oxide, and if carried to the point of surgical anesthesia may stop uterine contractions entirely; however, it is never possible to cause complete relaxation with nitrous oxide-oxygen. Neither cyclopropane nor ethylene is used in our Obstetrical Division because the intermittent use of one of these gases during analgesia would create a distinct explosion hazard.

After the premedication has been given, if ether is contraindicated, it is usually possible to carry the patient on nitrous oxide and oxygen without anoxemia. The percentage of oxygen given to the obstetrical patient should be watched carefully, and in some cases, due to the increased metabolism, it may be necessary to administer more than the usual amount. Various medications also decrease the minute volume of respiration. This decrease produces a decrease in the oxygen content of the blood, which may cause fetal anoxemia. Cyanosis should never be tolerated. According to Leake and Hertzman, et al, if anoxemia is present there is an initial increase in the arterial *p*H with inconstant changes in the carbon dioxide content, which may persist for fifteen to thirty minutes, depending on the degree of anoxemia. This will be followed by the fall of both the *p*H and the carbon dioxide content.

Anoxemia increases the fetal heart rate, but if oxygen is administered between contractions very little change will be noted. The baby will start to breathe more quickly if oxygen is given before the cord is cut. Excess carbon dioxide, other than that which accumulates from a normal amount of rebreathing, should be avoided. Increased carbon dioxide stimulates the baby to breathe, and, unless the mouth has been delivered, an excessive amount of amniotic fluid will be sucked into the upper respiratory tract.

The control of carbon dioxide is very important in any anesthesia, but particularly in obstetrical anesthesia, as metabolism is already disturbed and there is increased muscular activity present. This should also be watched closely in patients suffering from cardiovascular diseases or toxemia. Excessive carbon dioxide will cause hyperventilation, elevation of blood pressure, increased perspiration, loss of body fluids and a more marked acidosis which in turn will increase nausea and vomiting postanesthesia. Most physiologists believe that small percentages of carbon dioxide are stimulating to the respiratory center, but that higher percentages of carbon dioxide are direct depressants. The use of the filter in the closed method minimizes these dangers and it should be turned on during analgesia as well as anesthesia. The mother at the height of her pain has a tendency to hyperventilate, thus making it more difficult for her to breathe. The use of the filter at that time makes the patient more comfortable and prevents the feeling of suffocation. During anesthesia the filter is turned on when the desired plane of anesthesia is reached.

Patients who have had an intelligent antepartum education in regard to the physiology of labor and the means of relieving pain, have more satisfactory results from the medication and a safer labor and delivery. Our obstetricians ask their patients not to eat heavily after labor has started. I think that this is important both from the standpoint of the anesthetist and the patient. Unfortunately a large proportion of women vomit during pregnancy and labor, and vomiting is a dreaded complication in obstetrical analgesia and anesthesia. In a series of five hundred cases studied in 1938, I found that 30

per cent of the patients vomited. In the series of one thousand and eight cases during 1941 reviewed for this paper, I found that 29.7 per cent of the patients vomited. The results of these studies are shown in Fig. 1.

Vomiting occurs more often during light anesthesia, at which stage patients are less likely to aspirate because the throat reflexes are still present. Vomiting at the time the patient is approaching the maintenance stage of anesthesia, or during the delivery, is serious and may result in postoperative complications or immediate death. It is sometimes necessary to lighten the anesthesia during delivery to allow contractions, but if it is known that the patient has had food, the anesthesia should be kept below this reflex stage if at all possible. If the vomiting reflex is difficult to control, the patient is protected by giving ether by the semi-open method in preference to the gases. In some cases it is advisable, after the patient is unconscious, to stimulate the vomiting reflex in order to empty the stomach before the throat reflexes are abolished.

Every patient upon admission should be asked the time of the last meal and also when pains first started. Unless the patient gives a history of having had no food prior to the onset of pain, it should not be assumed that the stomach is empty. Digestion stops when labor starts and food may remain in the stomach for hours. In the first series one patient who vomited a large quantity of undigested food had not eaten for ten hours. Mothers should be warned by the obstetrician of the danger of taking food after pains start. We are all familiar with the mother who, after calling a taxi to take her to the hospital, has one last sandwich. The anesthetist should accept every case as an emergency and be prepared at all times for vomiting.

Case Report

Mrs. T———, a multipara, was admitted to the hospital one hour after the pains had started. She said she had not eaten solid food for seven hours. Upon examination the cervix was found to be three fingers dilated. She was quite uncomfortable during contractions, and ether was given.

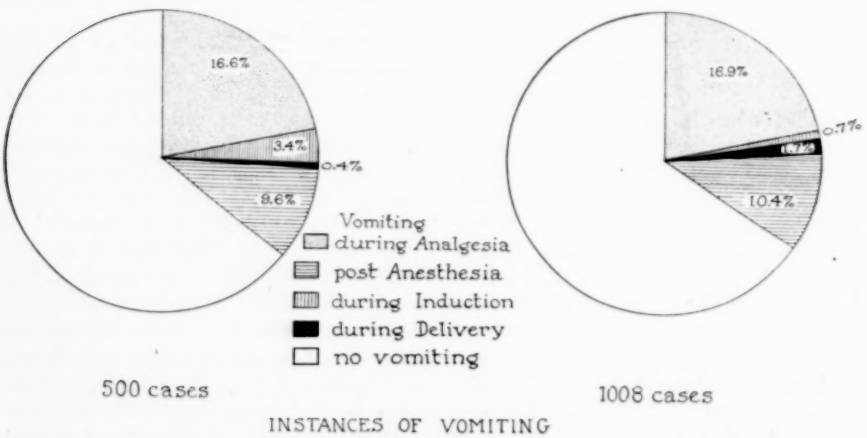

FIGURE I

The delivery, a breech extraction, was not difficult and was uneventful. The patient did not vomit during analgesia or anesthesia. The anesthesia was lightened after delivery and discontinued when the repair was completed. The patient was put to bed and began to react in about five minutes.

Suddenly, without any apparent cause, the respirations became very slow, with long periods of apnea. Respirations were about 8 to 10 per minute, pulse 92, blood pressure 112/80. The color remained good and there was no bleeding. The doctors were notified, and the chest and heart were examined. Everything seemed normal except respiration. During the next half hour 5 per cent carbon dioxide was given at five minute intervals, which increased the rate of respiration to 16, but the irregularity and periods of apnea still persisted. The patient responded when spoken to. An hour and a half after anesthesia was discontinued the patient vomited about 300 cc. of almost entirely undigested food. As soon as the patient had vomited, the respirations became regular and quiet—rate 20.

In both the series the medications given, and the type of analgesia and anesthesia were studied.—The time from the last meal until labor began and the time from the last meal until delivery were also noted. Various types of medication, and anesthetic drugs for analgesia and anesthesia were used. The choice seemed to play little or no part, as the incidence of vomiting was approximately the same. The following table shows the anesthetic agents used and the incidence of vomiting.

FIRST SERIES—

500 Cases

Drug Administered	*No. Cases*	*Incidence of Vomiting*	*Percentage*
Ether	311	94	30.2
Nitrous oxide-oxygen	110	30	27.2
Nitrous oxide-oxygen and ether	77	26	33.7
Intravenous	1	—	——
Local	1	—	——

SECOND SERIES—

1008 Cases

Ether	696	184	26.4
Nitrous oxide-oxygen	206	77	37.3
Nitrous oxide-oxygen and ether	88	35	39.8
Intravenous	8	3	37.5
Intravenous and gas	1	—	——
Local or no anesthesia	9	1	11.1

In the latter series the average length of time that ether or nitrous oxide and oxygen analgesia was administered was 20 per cent shorter. The average time per patient in 1938 was approximately one and a half hours, and in the latter series, 1941, one and a quarter hours. This reduction in time is due to the supplementary use of barbiturates during the

late first stage and early second stage of labor in the second series.

In the series of 1008 cases I have also studied the pulmonary complications which occurred postanesthesia. Thirteen patients, or 1.9 per cent, had pulmonary complications. Among this number there was one fatality, .09 per cent; this patient was admitted to the hospital antepartum with the diagnosis of pneumonia. Seven of these patients gave histories of colds on admission, one had sinusitis, one had a questionable cold, and three had no colds on admission (see Fig. II). The complications which occurred were as follows:

Lobar pneumonia	3
Bronchopneumonia	6
Aspiration during anesthesia	2
Atelectasis	2

Of this number, two patients had no anesthetic, and eleven had anesthetics. In the group which had anesthetics, five had no record of vomiting at any time, but one had mucus during nitrous oxide and oxygen analgesia. The remaining six vomited at some time during analgesia or delivery.

The treatment in these cases was as follows:

Sulfathiozole	7
Hyperventilation with 90 per cent oxygen and 10 per cent carbon dioxide	2
Oxygen tent plus sulfathiozole	3
Oxygen tent plus sulfathiozole plus hyperventilation	1

SUMMARY:

At the Maternity Hospital of Cleveland, morphine and scopolamine are given to primipara unless otherwise ordered by the doctor. We believe that if properly given they produce the most uniformly satisfactory results.

Anesthetists are on duty twenty-four hours a day, working in eight-hour shifts, to follow up medication treatment with ether or nitrous oxide analgesia.

Cyanosis is never tolerated because of the danger to both mother and baby. The soda lime filter is used to

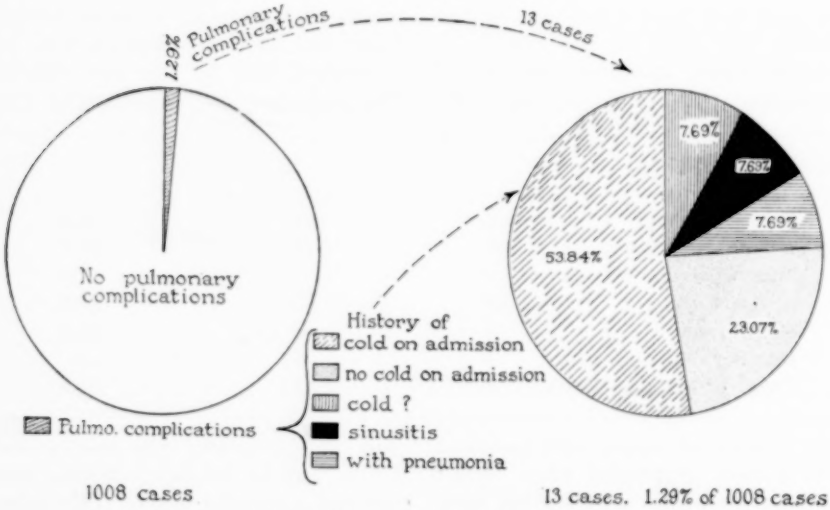

FIGURE II

prevent the accumulation of carbon dioxide.

In the two series of cases studied—500 in 1938 and 1008 in 1941, vomiting occurred in about the same percentage of cases. The type of medication administered apparently is of little significance in relation to vomiting.

In the second series, postoperative pulmonary complications occurred in 1.9 per cent of the cases.

THE ETHICS OF THE NURSE ANESTHETIST

SISTER JOHN EDWARD, S.C., B.S.

Good Samaritan Hospital, Cincinnati, Ohio

Read at the tenth annual meeting of the American Association of Nurse Anesthetists, held in St. Louis, Mo., October 12-15, 1942.

The rôle of the nurse anesthetist in the life of the patient is a most important one. As the individual administering the anesthetic she is enabled to render unconscious the organs of sense. And for what purpose? That painlessly the surgeon's knife may make repairs on the body afflicted by suffering. Is she a law unto herself or are her actions guided by principles, by standards that arise from the very nature of human beings? What is the purpose, the meaning of a human life? The answer to this question is the golden epitome of a true philosophy of life.

As the dual nature of man and his sublime destiny are evident realities, so the means given to perfect that nature must be obvious to all men—"Do good and avoid evil." This, the universal formula by which order is maintained in the moral universe, is the objective norm of morality, the basic principle of the science of ethics. It is the natural law, man's meager comprehension of the eternal law, or plan, in the mind of God in creating the universe. "Do good and avoid evil" is the criterion by which the quality of a human act is measured. If an act conforms to the norm, it is moral, if not, it is immoral. The natural law emanates from God alone. It is promulgated to all men by the light of reason.

What does correct reasoning dictate as an ideal in the matter of right and duty regarding interests in the life of the nurse anesthetist? Omitting much basic material of general ethics, we may suggest for example:

The duty of the Association to demand fulfillment of the requirements of the curriculum by Schools of Anesthesia. The right of the Director of the School of Anesthesia to expect cooperation from the hospital administration in maintaining the objectives of the Association. The duty of the chief anesthetist to maintain the standards of the curriculum; the right of the student anesthetist to expect their fulfillment. The right of teachers in Schools of Anesthesia to expect reasonable time for class preparation over and above time spent in actual supervision, and from time to time, leave of absence for study.

The duty of the anesthetist to report promptly on duty and in immaculate attire, confining the excessive application of cosmetics to periods when the uniform is not worn. The right of the chief anesthetist to expect a reasonable service from members of the department when on duty, cooperation in giving the best service, and economy in the use of supplies.

The duty of the anesthetist to accept office in the state or national association when duly elected or appointed.

The right of the anesthetist to expect a fair wage, reasonable working hours, and time allowed for attendance at state or national meetings, over and above vacation periods. The duty of the anesthetist to give sufficient notice in case of resignation. The right of the anesthetist to demand reasons for dismissal and adequate notice.

In these days of phenomenal advances in anesthesia occasioned by further discoveries of science and skill in surgery which seem to transcend the human in the surgeon, we find the members of the association having a skill in the administration of anesthetics commensurate with the progress made by related departments. It is an established fact that the department of anesthesia is an independent department and as such is directly responsible to the Chief Surgeon and to the Superintendent of the hospital. The chief anesthetist consults with and keeps the administration informed of any developments which are regarded as out of the ordinary routine. To the anesthetist really interested in her patient, it is not necessary to state that her responsibility does not end at the time when the anesthetic is discontinued, but extends to the time when the patient reaches his ward or room, when he is given into the charge of the supervisor. In cooperation with the surgeon, she will watch the progress of the patient so that by her judgment and experience she can aid in interpreting any untoward symptoms which may arise, especially during the first three days postoperatively.

While this duty will be repaid by increased knowledge of the patient's reaction to the anesthetic, by the gratitude of the patient when visited, and the appreciation of the surgeon who will necessarily be aware of her conscientiousness in the follow-up service, it is one of the best means by which our members may prove to the hospital world nationally that the interest of the anesthetist does lie in the patient; reward or financial gain is a subordinate consideration. Fidelity to duty within the sphere of life in which one is employed is the measure of one's real worth and outranks external success and justifies the esteem which one enjoys. Esteem is the good opinion which one person has formed and entertains of another. Esteem is an object of acquired right, so that to take it away or to diminish it is an act of injustice. Not only has the individual a right to esteem but a similar right is enjoyed by a community, a state, or a city, and organized bodies of individuals. For example, we hold each other in esteem as fellow members and in proportion as we esteem our associates we respect them, so in turn do we hold in esteem the organization of the American Association of Nurse Anesthetists.

The good name of an individual, that is to say, the high opinion which others have of her and the external honor which they pay her, are important possessions both from the individual and from the social point of view. On the one hand, they afford internal satisfaction, and on the other, they exercise a considerable influence upon the position and activity of an individual by giving her authority and influence among her co-workers and associates. Thus the good name and honor of fellow beings constitute an ethical possession of great social importance which must be duly respected for the same reasons which oblige each individual to protect her personal reputation and honor. It is

our duty to give to our associates the honor that is due, to readily acknowledge their excellencies or merits; to promote their acknowledgment by others, and to defend them from unjust attacks.

Among the undesirable character traits which may enter the life of the nurse anesthetist are calumny and slander which falsely impute to another something which injures or destroys her reputation, and usually consists in accusing falsely or in exaggerating faults or denying good qualities or wilfully misinterpreting intentions.

Detraction is the unjust violation of the esteem of an individual by making known to others some true or hidden fault of that other person. Calumny differs from detraction only in that what is said or imputed to another by calumny is false in fact and is known to be false. Detraction, calumny and the like obligate us to make restitution as far as possible.

Neither the duty of telling the truth nor the virtue of veracity demand that the anesthetist disclose everything that she knows always or to all men. On the contrary, she is sometimes bound to withhold knowledge or information from others. A secret is something hidden or concealed, or more properly, knowledge or information which we are in duty bound to keep from others. We are morally bound not to divulge personal or professional knowledge concerning our patient, the obligation resting upon the fidelity without which the social order could not exist. More particularly, the obligation of secrecy is gauged by the nature of the secret. So-called natural secrets are based upon the obligation of justice which man owes to his fellowman and which admits of exceptions for just reasons and does not exclude silent reservations.

It will be evident that when a secret has to be kept, some form of words may be employed that express the veiled truth and at the same time occasion the deception of the hearer. Though this procedure is to be preferred on the clear principle of mental restriction, others defend it on the ground of legitimate self-defense in the following way. The employment of words that appear to be untruthful is an act of self-defense against wordy aggression and it is legitimate in those circumstances, though in other circumstances it would be a lie. This self-defense or defense of the patient takes the expression out of the category of lying, for as in legitimate self-defense, one's defensive action, which in other circumstances would be homicide, is here and now an act of legitimate self-defense, so too, words which would otherwise be lies, are, if used in defense of a secret, defensive words, and as such are alone chosen and intended. If they result in deception, the deception is allowable, it is not intended primarily, but is only permitted. Mental restriction is not permitted when one is legitimately interrogated by a judge, those to whom one is professionally responsible, nor on entering into legal contracts.

The statement has been made that a lie is never permissible, because lying is always an abuse of the faculty of speech. The plea often urged, namely, that the questioner has not always a right to the truth, and that therefore a lie may be told, is a plea that attempts to justify the violation of the primary and essential purpose of the faculty of speech.

To constitute a lie, the false declaration, whether made in word or deed, must be opposed to the interior conviction or belief of him who makes it, and further misleads others, especially those who have a right to know the

truth. The matter of a lie, therefore, is the truth unuttered—not objectively, however, but subjectively, i. e., as opposed to that which one knows or believes to be true. Consequently, an objectively false statement which one believes to be true is no lie and vice versa, an objectively true statement which one believes to be false is a lie. It is the intention that constitutes a lie. These are typical problems and situations which the nurse anesthetist encounters in applying the all-embracing norm of morality, "Do good and avoid evil," to professional problems of everyday life.

In the case of our association, membership gives rise to specifically new relations on which duties are grafted, outlining objectives for the good of the individual anesthetist and the organization as a whole. The privileges accruing from it are many—to be associated in a group which is devoting time, energy, nay, even life, to alleviate suffering humanity, is a veritable inspiration. An impetus to go on and do greater and better things comes with a dynamic force when one learns the sacrifices that are made, the obstacles overcome. While each anesthetist carries on personal activities, the organization has a corporate activity, national in scope and importance in the hospital world, directed by officers of the Association in whom this authority is vested.

The Association has a membership of women who have a concept of life essential to the life-long task of developing and modifying character according to sound principles of conduct and worthy ideals. Evaluating truth in the light of eternal principles, she disregards the naturalistic concept which looks upon life simply as a struggle for existence, characterized by endless and bitter competition wherein economic values have entirely supplanted moral ones. Because of the anesthetist's correct ethical ideals, she is a woman who will look bravely at issues and even though the rational decision may be contrary to the softness of human nature, will gladly carry on so that the principle be not lost, realizing that she is a rational being and some day will be held responsible for all rational acts.

Each of us is indebted for the personal sacrifices made by members who have held positions of authority in this organization since its inception. They established the ideals and standards we possess today. This heritage brings with it the duty of preserving and enhancing its values, of maintaining and accomplishing our present objectives, so that we may continue to fulfill our pledge to suffering humanity and the generation of anesthetists to follow.

May the ideals and objectives given birth in the heart of our esteemed and honored first president of the American Association of Nurse Anesthetists, Miss Agatha Hodgins, be maintained and continued in the hearts of our officers throughout the years to to come.

May I say that I voice the good will and devotion of the assembly when I pledge the fealty of each and every member to labor for the interests of her association?

Is it difficult to attach the thought to our daily work that we who are privileged to alleviate pain so continuously day after day , have been elected to a special task in relieving the sufferings of humanity? The merely humanitarian view does not do full justice to the real mission of the nurse anesthetist, which to reach its highest ideal must find its inspiration in God Himself. This is the inspiring thought which lends a dignity to the most menial tasks connected with our specialty and raises it high above the

indifference of mankind. When we realize that the duty we fulfill fits into the divine plan, we sense that our work, no matter how fortuitously we may seem to have chosen it, is in a very true sense a special privilege. It is like an appointment to continue by the administration of anesthesia the work of healing Christ began here on earth.

NOTICE

In the Annual Report of the Public Relations Committee, which was published in the November, 1942, issue of the Bulletin, is was recommended that the Legislative Committees of the State Associations follow certain procedures. It is requested that all State Secretaries notify the Chairman of the Public Relations Committee of the American Association of Nurse Anesthetists (Hazel Blanchard, 2342—15th Street, Troy, New York) of the names and addresses of the State Committee Chairmen and that each Chairman send the above-mentioned Chairman her report at once.

Will the Chairman of each Sectional Assembly now functioning, immediately file formal notification with the President of the American Association of Nurse Anesthetists of the existence of such Assembly (see page 256, November 1942 issue of the Bulletin).

NOTICE TO STATE ASSOCIATION SECRETARIES

Referring to the many inquiries in regard to associate members who wish to be classified as active:—

The by-laws state specifically that an associate member who, at the time of her application was eligible for active membership, but for satisfactory reasons desired associate membership, if she later wishes to become an active member, must make re-application for active classification and pay the required $2 application fee. (Article V, Section 4c)

The by-laws also state that an associate member who was approved for active membership and paid dues as such, but for satisfactory reasons later became an associate member and again desires active membership *after a period of more than two years,* must re-apply for active membership. (Article V, Section 4d)

If the period of associate membership is less than two years, she is required merely to fill out a special form, stating her reasons for wishing change of classification, and upon payment of the active dues of $6.00 she will become an active member again.

DEPARTMENT OF EDUCATION

METHOD OF CALCULATING THE PERCENTAGES OF INDIVIDUAL ANESTHETIC AND THERAPEUTIC GASES CONTAINED WITHIN AN ADMINISTERED MIXTURE

HELEN LAMB
Barnes Hospital, St. Louis, Mo.

Foreword:

With the advent of machine-administration of anesthetic and therapeutic gases, the need for calculating the *percentage* of the several gases embodied within an administered mixture, became an important part of anesthesia technique.

Whereas such "percentage" computations had been unnecessary in the administration of drop ether (the local irritant reaction of which promptly warned the anesthetist of approaching high concentrations, before the tension of the vapor reached apnoeic levels) such clearly evident advance forewarning did not always present itself at the administration of sub-oxygenated nitrous oxide mixtures to certain individuals, (anemic, icteric, et cetera); or at the administration of high concentration carbon dioxide mixtures to unconscious patients. In the case of nitrous oxide-oxygen mixtures, "uncalculated percentage" administration could result in initial delivery of *asphyxial tensions* of the mixture. In the case of mixtures containing carbon dioxide, "uncalculated percentage" administration could result in accidental delivery of *damaging concentrations* of that agent. In the case of mixtures containing potent cyclopropane, uncalculated percentage administration could result in the presentation of toxic concentration of that gas to the patient. "Uncalculated percentage" administration of combinations which includes helium (a simple asphyxiant when administered without a sufficient accompanying protection of oxygen) could result in damage from anoxia.

Obviously, the calculation of percentages of the gases embraced within a delivered mixture became a highly important function of the anesthetist who administered these modern anesthetic and therapeutic gases. In computing the percentage of an individual gas contained within a given mixture, it is to be borne in mind that a statement of the "percentage concentration" of that gas represents its relation to the *entire mixture of gases*, not merely to one other gas contained within the mixture. In the past, confusion was introduced when literature stated, and some anesthetizing machines were calibrated in, graduations which indicated the percentage of oxygen merely in terms of its relation to one anesthetic gas contained in the mixture, instead of to the total volume of the mixture of gases which was to be delivered to the patient.

As an illustration of the earlier technique: administration of a mixture composed of "130 gallons of nitrous oxide" and "26 gallons of oxygen," was stated by some writers (and was indicated by some machine calibrations) to contain *20 per cent of oxygen;* whereas in reality such mixture contained only 12.82 per cent of oxygen. What was meant by the statement of those commentators, and by the calibration of the machines, was that the mixture contained 20 per cent as much oxygen as it did nitrous oxide, which is an entirely

different thing than the *physiologically* important factor of the percentage of oxygen contained within the total breathed mixture.

Method of Calculation of Percentage:

To calculate the percentage of a given gas contained within an administered mixture, the *total volume* of flow of the *combined* gases is noted as the basis of the calculation. Such total flow, representing as it does the *entire amount*, constitutes *100 per cent.* For example: if anesthesia is being induced by an administrative mixture consisting of 4 liters of nitrous oxide and 1 liter of oxygen, the *total volume* of gases (5 liters) becomes the basis of the calculation, as constituting 100 per cent of the flow. Of this total flow of 5 liters, the 4 liters of nitrous oxide constitute 4/5 or 80 per cent of the total flow. The liter of oxygen constitutes 1/5 or 20 per cent of the total flow. Similarly, if anesthesia is being maintained by valvular mask continuous flow method, with a mixture consisting of

2 1/2 liters nitrous oxide	(2500 cc.)
1/2 liter oxygen	(500 cc.)

the total volume of 3 liters (3000 cc.) constitutes 100 per cent. Of this total flow of 3000 cc., the 2500 cc. of nitrous oxide constitute 2500/3000 or 83-1/3 per cent, whereas the 500 cc. of oxygen represent 500/3000 or 16-2/3 per cent of the mixture.

Illustrating further: if hyperventilation is being conducted by administration of a mixture consisting of

2 liters oxygen	(2000 cc.)
2 liters helium	(2000 cc.)
400 cc. carbon dioxide	(400 cc.)

the total delivery of 4400 cc. constitutes 100 per cent of the administered mixture. Of this 4400 cc. total flow, the 2 liters (2000 cc.) of oxygen constitute 2000/4400 of the flow, or 45.45 per cent of the mixture administered (45 per cent plus). Similarly, the 2 liters of helium constitute 2000/4400 of the flow, or 45.45 per cent. The 400 cc. of carbon dioxide constitute 400/4400 of the flow, or 9.09 per cent of the administered mixture.

NOTE: As a reminder of the rule for converting common fractions into per cent, such rule is here re-stated:

Rule No. 1. "To convert a common fraction to per cent, multiply the numerator by 100 (by adding two ciphers), then divide by the denominator."

Illustrations:—

4/5 (four-fifths) = 4 x 100 = 400; 5)400

80% (eighty percent)

1/5 (one-fifth) = 1 x 100 = 100; 5)100

20% (twenty percent)

As a reminder of rules for converting common fractions *first* to "decimal fractions" and *then* to percent, the following are stated:

Rule No. 2: "To convert a common fraction to a decimal, divide the numerator by the denominator."

Illustrating Rule No. 2:

4/5 = 5)4.00

.80 (eight tenths) or (eighty hundredths)

1/5 = 5)1.00

.20 (two tenths) or (twenty hundredths)

Rule No. 3: "To express a decimal fraction as per cent, move the decimal point two places to the right and add the word or symbol per cent (%)."

Illustrating Rule No. 3:

The decimals "eighty hundredths" and "twenty hundredths" are converted to "percent" by moving the decimal point two places to the right and adding the percent designation:

.80 (eighty hundredths) = 80% (eighty percent)

.20 (twenty hundredths) = 20% (twenty percent)

In Conclusion:

The importance of calculating the percentage of individual gases contained within an administered mixture is at once apparent, when the student bears in mind some basic pharmacological facts, such as:—

(a) Adequate oxygen concentration in a breathed mixture is of vital importance *physiologically.* (Anoxemic mixtures must be meticulously avoided).

(b) Nitrous oxide, being of relatively low anesthetic potency, is usually administered at a high concentration that is near to the tension at which by encroaching upon required oxygen tension, it could introduce asphyxial damage.

(c) Carbon dioxide introduces *toxic* reactions if permitted to constitute too high a percentage of (reach too high a concentration in) an administered mixture.

(d) Helium, while an inert gas, acts as a simple asphyxiant when permitted to constitute too high a percentage of a breathed mixture, (when its percentage is permitted to encroach too far upon the physiologically necessary tension of oxygen in an inspired mixture).

ADDENDA

Arithmetical Terminology

The word "percent" (written symbol %) is derived from the Latin words per centum, meaning "by the hundred." Its translation into our usage might be stated as *hundredths of a whole.* To illustrate, "twenty-one percent" (21%) is merely another way of stating 21/100 (twenty-one hundredths). That value may be written in several ways, according to the system used, for instance,

as a "common fraction," 21/100 (twenty-one hundredths)
as a "decimal fraction," 0.21 (twenty-one hundredths)
as "percentage," 21% (twenty-one percent)

An examination of the last two forms tabulated above, develops the fact that when the designation "percent" (%) is used, the "decimal point" of the

"decimal fraction" is moved two places to the right, (thus multiplying that decimal fraction by one hundred) and then designating the result as *percent.* (either using the word "percent" or its symbol "%"). At this point, a few reviewing definitions relating to arithmetical terminology may be timely.

A *fraction* is a part of anything that as a base is considered to be an entirety. In other words, a "fraction" is a "portion" of a "whole."

A *common fraction* is the designation of a numerical value by means of a number above and a number below a "fraction line." To illustrate:—

1/4 (one *fourth*), 3/20 (three *twentieths*), 45/100 (forty-five *hundredths*), 755/1000 (seven-hundred-and-fifty-five *thousandths*)

The numbers above the fraction lines (1, 3, 45, 755) are the *numerators* (announcing the *number* of units contained within the fraction); the numbers below the fraction lines (4, 20, 100, 1000) are the *denominators* (denoting the *size* of units into which the whole has been divided).

Decimal fractions. When the denominators of fractions are tenths, hundredths, thousandths, ten-thousandths, et cetera, the numerators may be written without the denominators, those denominators being replaced by the use of a "decimal point" and suitable ciphers. Thus in the *decimal system*, "common fractions" whose denominators are 10, 100, 1000, 10,000, et cetera, could be written as "decimal fractions," as follows:

one tenth	1/10	=	0.1
one hundredth	1/100	=	0.01
one thousandth	1/1000	=	0.001
one ten-thousandth	1/10000	=	0.0001

Decimal fractions are more convenient to use than common fractions for ordinary arithmetical calculations (addition, subtraction, multiplication, division, et cetera).

Recapitulating the foregoing, and extending it to our calculations of gas percentages, it will be seen that the first step in our calculation consists of resolving the various gas flows to *common fractions* (4/5, 1/5, 2000/3000, 500/3000 (pages 39 and 40) and then converting those common fractions to *decimal fractions;* then expressing those decimal fractions in terms of *per cent* in conformity with customary terminology.

NOTICE

The government has made a ruling recently that no publications can be mailed to persons in the armed forces overseas except direct from the publisher—they cannot be addressed to a relative or friend and then forwarded to the individual.

Any members in the service overseas who wish to receive their copies of the Bulletin during the emergency must keep us informed of their address so that the Bulletin may be mailed directly to them.

SIGNS OF ANESTHESIA

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Foreword

We believe that it is best to teach signs of anesthesia during the first month of the student's training. The student in this way has an early understanding of the phenomena which develop during the administration of an anesthetic. This plan has the disadvantage in that it makes it more difficult to present the material to the student because she has not had the classes in physiology. To overcome this disadvantage we have included in the notes on "Respiration" some material which is later given to the students in their regular course of lectures.

Most of the material in the notes presented has been compiled from the following authorities:

"Inhalation Anesthesia: a Fundamental Guide"
by Arthur E. Guedel

"The Physiology of Anesthesia"
by Henry K. Beecher

"Pharmacology of Anesthetic Drugs"
by John Adriani

"Physiology in Health and Disease"
by Carl J. Wiggers

"Physiology and Anatomy"
by Esther M. Greisheimer

The students are not given the notes but are assigned definite chapters, pages, et cetera, from the above mentioned textbooks and are required to make their own outline, which is later corrected to conform to the outline as used by the instructress.

Guedel's outline of the stages of anesthesia is used. After the introductory lecture the first fifteen minutes of each class hour are devoted to an oral quiz. A written test is given following the lectures on respiration and a final examination when the classes on this subject are completed.

Stages of Anesthesia

Stage I — Analgesia. This is the period from the beginning of the administration of the anesthetic until the loss of consciousness. It is characterized by loss of sense of pain without loss of consciousness or sense of touch.

The higher activities of the cortex are depressed, but mental control is present. There is increasing impairment of reasoning as anesthesia progresses due to interruption of association paths and "long-circuiting" of ideas. For this reason it is advisable to use clear, concise sentences when talking to the patient during induction. Hearing is acute at this time, therefore the operating room should be quiet.

Pain sense is abolished just before consciousness is lost. Relative, or conscious analgesia, is the period just before the point of pain abolition. Total analgesia is that period when pain sense is abolished. It is difficult to maintain because of its proximity to Stage II (Guedel).

During this stage false anesthesia—presenting a picture of third stage

anesthesia—may develop, as a result of fear, extreme mental depression or hysteria. The anesthetist should encounter little if any difficulty in differentiating between false anesthesia and true surgical anesthesia.

Stage II — Delirium or Excitement Stage. This is the period of earliest loss of consciousness. The sensory and inhibitory areas of the cortex are depressed; the cortico-thalamic fibers are interrupted. Since the activity of the higher centers is abolished, the secondary centers are free to produce their uninhibited and more primitive manifestations. Nervous response to stimulation or to concurrent dreams is exaggerated and expressed in more or less violent physical activity. Muscle tone increases, the jaw is set, eyes closed, and skeletal muscles stiffen.

This is the *potential danger stage* in every general anesthesia. The dangers are:

1. Ventricular fibrillation and other circulatory accidents, including cerebral hemorrhage
2. Physical injury.

Proper management of this stage to avoid these dangers is accomplished by:

1. Smooth, rapid induction
2. Avoidance of any external stimulation
3. Preanesthetic reduction of nervous irritability by means of premedication
4. Proper restraint of the patient.

Stage III — Surgical Anesthesia

Plane 1. Light anesthesia. The onset of this plane is marked by the appearance of full, regular respiration. Eyeball activity is present, but diminished. There is no relaxation except for the smaller muscles.

Certain reflexes are lost—

Eyelid reflex is lost early in this plane.

Pharyngeal reflex is abolished in mid-plane.

Stimulation of the pharynx by the irritating effects of the anesthetic agent or by the use of an airway before the reflex is abolished will produce vomiting. Vomiting will also occur when the center is stimulated by asphyxia, and by increased intracranial pressure.

Cough reflex produced by irritation of upper respiratory tract is abolished in the mid 1st plane.

Nerve trunk reflexes are abolished in lower 1st plane (this is sufficient anesthesia to abolish response to traction or to severance of sciatic nerve).

Plane 2. Full anesthesia. The onset of this plane is most clearly marked by the cessation of eyeball activity. Muscular relaxation is fairly good.

The laryngeal reflex is depressed in the upper plane, although some response to the deep traction reflexes still persists even to the 3rd plane.

The cough reflex is abolished.

Pupillary dilatation begins in mid-plane (if premedication has not been given).

Plane 3. Deep anesthesia

The onset of this plane is marked by beginning intercostal paralysis.
Muscular relaxation is good.
Pupils are dilated.

Plane 4.

Complete intercostal paralysis.
Beginning diaphragmatic paralysis.

Stage IV — Respiratory paralysis

Explanation of terms commonly used in referring to the stages of anesthesia:

INDUCTION: The period from the beginning of the administration of the anesthetic to the onset of the surgical stage.

MAINTENANCE: From the beginning of the surgical stage to the beginning of the permanent reduction of the anesthetic.

RECOVERY: From the beginning of the permanent reduction of the anesthetic until the return of consciousness.

RESPIRATION

Anatomy and Physiology

The respiratory system includes the organs involved in the interchange of gases between the blood and the air. It consists of air passages, air sacs, pulmonary blood vessels, and the organs concerned with inspiration and expiration and the control of these processes.

Air passages: Convey air to and from the lungs. Consist of nasal cavity, pharynx, larynx, trachea, bronchi.

Air sacs: Diffusion of gases to and from the blood takes place here. The primary respiratory structure is the respiratory epithelium and the capillaries in contact with it. The respiratory epithelium is located in the walls of the alveoli.

Mechanism of respiratory movements:

The thoracic cage is formed by ribs, sternum and diaphragm. Air moves in and out of the lungs because of the difference in pressure, the pressure in the lungs being less than atmospheric pressure during inspiration.

Inspiration:

The chest is enlarged by (1) elevation of ribs
(2) descent of diaphragm
This is an active process.

Expiration:

The chest cavity becomes smaller because
(1) inspiratory muscles relax
(2) the thorax returns to rest position.
This is a passive process, except when breathing is labored.

"Pneumograph records indicate that inspiration is slightly shorter than expiration and that it occurs more rapidly. At slow rates a short expiratory pause exists which disappears when the respiratory rate reaches 14 to 16 per minute. Thoracic and abdominal breathing co-exist."—Wiggers.

Control of Respiration:

Nervous control:

Respiratory movements are under the control of a center located in the medulla oblongata. This center sends impulses to the nerve cells whose axons supply the muscles of respiration. This process is automatic but its activity is influenced by various nervous impulses.

Nervous impulses which affect activity of respiratory center:

1. Voluntary control—impulses may reach the center from the cells in the motor cortex of the cerebral hemispheres. This control is limited.
2. Reflex response to any sensory nerve.
   Painful stimulation, alarming sights or sounds will alter respiration.
3. Reflex response to special sensory nerves along respiratory passages—receptors stimulated by irritating substances. Coughing, sneezing, temporary inhibition of respiration may result.
4. Reflex response to nerves in lungs.
   The vagus nerve receives afferent fibers from the lungs. Expansion of the lungs stimulates pulmonary stretch receptors and causes inhibitory impulses to travel over the vagus. This cuts short inspiration when a sufficient degree of ventilation has been attained (Hering-Breuer theory).
5. Reflex response to changes in the carotid sinus.
   Increase in blood pressure leads to reflex inhibition of respiration; a fall in blood pressure leads to stimulation of respiration.

Chemical Control: The activity of the center is affected by physico-chemical changes of the blood.

1. Carbon dioxide content of the blood acts as chemical stimulus to the respiratory center.
   Respiratory activity depends upon the relation between the respiratory threshold (the irritability of the respiratory center) and the carbon dioxide content of the blood.
   If carbon dioxide accumulates, respiration is stimulated. If it decreases, respiration is depressed.
2. Changes in hydrogen ion concentration.
3. Reduction of oxygen tension.
4. Changes in temperature.

Volume Relations of Respiration:

Tidal volume: amount of air moved into and out of the lungs during one inspiration and expiration; approximately 500 cc.

Minute volume: tidal volume multiplied by number of respirations per minute.

Complemental air: amount of air taken in deepest possible inspiration: 1600 cc.

Supplemental air: amount of air moved out by maximum forced expiration: 1600 cc.

Vital capacity: the sum of supplemental, tidal and complemental air: about 4100 cc.

Residual air: that air which cannot be expelled from the lungs even by forced expiration—about 1200 cc.

Dead space air: that which remains in the air passages. It plays no part in exchange of gases. It amounts to about 140 to 150 cc.

Factors affecting the efficiency of alveolar ventilation:

1. Capacity of the dead space:
   This is increased in the closed system of anesthesia, resulting in a decrease in effective tidal volume.
2. Minute volume:
   A slow rate plus large tidal volume will result in a more complete renewal of alveolar air, than will a fast rate with a shallow volume.

Diffusion of the anesthetic agent to and from the tissues takes place across the capillary walls, consequently the air which sweeps through the alveoli is that which is effective in producing or maintaining the concentration of the anesthetic agent in the blood.

Rapid induction of anesthesia depends upon volume of respiration; complete saturation of body tissues depends upon efficient alveolar ventilation, and on circulation. Efficient alveolar ventilation is most effectively accomplished by a large tidal volume.

Definitions of Respiratory Reactions:

Hyperpnea: increased volume of respiration
Hypopnea: decreased respiratory volume from lack of effort
Dyspnea: increased inspiratory volume with forcible expiration
Apnea: cessation of breathing, either in inspiratory or expiratory position.

Causes of apnea:

1. Following hyperventilation
2. Depression from overpremedication—administration of oxygen removes the stimulating effect of oxygen lack. Spontaneous respiration will occur when carbon dioxide tension is sufficient to stimulate center.
3. Overdistension of alveoli.

Character of Respiration during Anesthesia:

Respiration is the most important sign of anesthesia.
Note the rate, rhythm and volume.
Always observe the character of respiration before starting the anesthetic.

1. *Age:*
   Normally the rate of respiration depends upon the age.
   Average rates:
   Newborn—40 or more per minute
   Infant—30
   Child (five years)—25
   Adult—16—20

2. *Condition of patient:*

The rate and volume of the respiration are usually influenced by disease, e. g.: rate is increased when temperature and basal metabolic rate are increased.

Volume is decreased in patients having a reduced vital capacity, as in tuberculosis or emphysema.

In certain cardiac diseases dyspnea occurs.

3. *Premedication:*

Morphine depresses rate and volume of respiration. It raises the respiratory threshold for carbon dioxide.

Barbiturates depress rate, decrease volume slightly.

Avertin depresses rate and tidal volume markedly.

4. *Emotional disturbance:*

Fear and excitement produce varying effects on respiration. The rate and volume may be increased or may be decreased due to voluntary holding of breath. Irregularity of rhythm may occur.

5. *Anesthetic Agent:*

There is initial stimulation when an irritating anesthetic agent is used. If the vapor is highly irritating, breath holding, or laryngeal spasm may occur. Respiratory threshold for carbon dioxide is lowered by the anesthetic agent at first, therefore there is an increase in volume.

6. *Method of Administration*

More stimulation (increased volume), with closed method because of accumulation of carbon dioxide.

7. *Obstruction to respiration*

8. *Chemical content of blood:*

Changes in carbon dioxide tension

Changes in hydrogen ion concentration

Oxygen deficiency.

9. *Painful stimulation:*

Afferent impulses from somatic and visceral nerves affect respiratory center. Effects may be inhibitory or accelerating.

10. *Position of patient:*

Trendelenburg or other inhibiting position tend to decrease volume.

Gallbladder or thyroid brakes may inhibit free respiration and reduce volume.

Respiration During Anesthesia:

Stage I

Early—tidal volume and rate should be normal provided that there are no interfering factors.

Rate and volume increase somewhat as the anesthesia progresses due to increase in irritability of the respiratory center from the effects of the anesthetic agent and because of the accumulation of carbon dioxide.

Stage II

Respiration is of no value as a guide in this stage. It is irregular; reactions started in first stage are carried over into this stage.

Mental control is lost.

Stage III, Plane 1

Beginning of plane marked by onset of full, regular respiration; the rhythm is regular, mechanical in character.

Volume is usually increased.

This depends upon the efficiency of the respiration in the preceding stages. If carbon dioxide has accumulated because of inefficient respiration, the tidal volume will be greatly increased during this plane. If the second stage was characterized by marked hyperpnea, carbon dioxide tension in the blood will be low and respiration will be depressed (Beecher).

Response to reflex stimulation is not depressed in this plane, therefore changes in rate and volume will occur as a result of surgical stimulation.

The character of respiration should approach normal after the balance between the respiratory threshold and the carbon dioxide content of the blood is adjusted. (Excess carbon dioxide removed by soda lime).

Inspiration is shorter and slightly quicker than expiration. There is a pause at the end of expiration.

Plane 2

There is slight difference between the respiration of Plane 1 and 2. Volume is usually decreased. The rate may be slightly increased (Beecher), or somewhat slower. As the rate increases, the pause at end of expiration disappears, and inspiration and expiration appear more equal in length.

The response to reflex activity is lessened; response to deep traction reflexes still exists, however (traction on pelvic organs and splanchnic viscera, et cetera).

Plane 3

Marked by beginning intercostal paralysis.

Delayed thoracic inspiratory effort is the first evidence of intercostal paralysis. Thoracic movements decrease in amplitude.

Inspiration is short and jerky (gasping); it becomes increasingly shallow and gasping.

Diaphragmatic descent becomes a quick, jerky movement long before intercostal paralysis is complete.

Plane 4

Intercostal paralysis complete.

Diaphragmatic paralysis begins.

Inspiration becomes more shallow and gasping; rhythm irregular.

Abdomen sinks on inspiration.

Stage IV

Respiration ceases.

FACTORS PRODUCING RESPIRATORY CHANGES DURING ANESTHESIA

Rate +	Rate —	Volume +	Volume —	Changes in rhythm
Fear and excitement	Premedication	Increase in CO_2 tension	Decrease in CO_2 tension	Fear and excitement
Irritant action of anesthetic agent	Fear	Fear and excitement	Deep anesthesia	Obstruction
Surgical stimulation	Reflex stimulation	Reflex stimulation	Premedication	Respiratory fatigue
Anoxia	Obstruction (initial response)	Obstruction	Respiratory fatigue	Reflex stimulation
Respiratory fatigue	Deep anesthesia		Prolonged anoxia	Cerebral hemorrhage
Shock			Shock	Pulmonary embolism

OBSTRUCTION TO RESPIRATION:

Maintenance of a free airway is of greatest importance in anesthesia.

Obstruction of respiration reduces the efficiency of the gaseous interchange and is the direct cause of pathological changes in the lungs. (Pulmonary edema—evidenced by production of fine, frothy mucus).

Causes of obstruction:

1. Poor position of head (over-extended head causes increased intracranial pressure)
2. Relaxed jaw; jaw spasm
3. Relaxed tongue
4. Laryngeal spasm
5. Edema along any part of airway
6. Pressure from tumors
7. Foreign bodies—blood, mucus, vomitus
8. Density and viscosity of gases
9. Elasticity of lungs
10. Inhibiting positions (Trendelenberg, prone, et cetera)
11. Overdistention of breathing bag offers abnormal resistance—interferes with Hering-Breuer reflex.

Discussion of Causes of Obstruction:

Jaw spasm:

Caused by lack of oxygen (fear can be a contributing factor)

Prevention:

Always insure clear airway. This is especially important when anesthetic has been discontinued. Pull lower lip open to allow more air.

Treatment:

Open lips with fingers.
Insert nasal tubes.
Give adequate oxygen.

Relaxed tongue — Stertor

Stertor is a snoring sound produced by the vibration of the relaxed tongue against the pharyngeal wall.

Obstruction occurs both on inspiration and expiration.

Causes:

Overconcentration of anesthetic agent
Lack of oxygen
Deep anesthesia.

Treatment:

Lessen partial pressure of anesthetic agent.
Relieve obstruction—correct position of head.
Maintain adequate oxygen supply.
Insert airway if necessary.

Lip Stertor:

Causes:

Pressure (e. g., from face mask. Pressure over the eyes affects respiration as does any painful stimulus).

Concentration of anesthetic agent. There is a lack of adjustment to the anesthetic concentration; equilibrium has not been established.

Treatment:

Relieve pressure

Deepen anesthesia—the condition will correct itself when equilibrium is established.

Laryngeal Spasm:

Definition: Spasm of the adductor muscles of the vocal cords causing obstruction on inspiration and also on expiration. It produces a crowing noise on inspiration which is known as stridor.

Causes:

1. Direct irritation of vocal cords by anesthetic agent (overconcentration of ether)
2. Interference with recurrent laryngeal nerves
3. Reflex stimulation from the operative field
   e. g., traction on uterine attachments, mesentery, splanchnic viscera, peritoneum, stretching of anal and vaginal sphincters.
   In gallbladder surgery the characteristic "gallbladder grunt" is produced by expiration against the closed vocal cords.

Treatment:

1. Discontinue ether.
2. Increase pressure of oxygen in breathing bag.
   (If color is good and anesthesia light, pressures of gases may be increased proportionally).
3. Deepen anesthesia if due to reflex stimulation.
   Great care must be taken when doing this to avoid aggravating the condition by overconcentration of ether.

4. When due to direct stimulation of laryngeal nerves (as in thyroid surgery), adjustment of clamps to relieve stretching or interference with the nerve will usually improve condition.

Laryngeal spasm may occur during any stage of anesthesia, but is less frequent in the deeper planes.

Responses to Respiratory Resistance:

1. Slowing of rate and increased depth

   Explained by action of Hering-Breuer reflex;

   filling or emptying of lungs slowed by increased resistance, but when certain point is reached vagal stimulation causes change in respiratory phase. Carbon dioxide accumulates, so that next breath is deeper.

2. Increase in rate, diminished volume—when resistance is excessive. This occurs because of development of anoxia and respiratory fatigue.

Inspiratory obstruction:

Effects more serious—more anoxia and carbon dioxide retention. Greater increase in rate, marked decrease in tidal volume and minute volume.

Expiratory obstruction:

Slows rate, increases depth, but constantly decreases minute volume.

Results of Respiratory Resistance:

1. Dyspnea and cyanosis
2. Inefficient exchange of gases, resulting in anoxia
3. Respiratory fatigue

When resistance is prolonged alveolar ventilation becomes less effective—anoxia develops. Respiratory center becomes fatigued by oxygen deficiency. The respiratory muscles tire from the effort produced by the resistance. The respiration becomes progressively shallow and rapid, and arrythmic.

Treatment:

Increase oxygen percentage.

Helium is beneficial — transports oxygen with minimum required effort.

In rare cases it may be necessary to resort to open method.

4. Pulmonary congestion and edema.

Oxygen Want:

Asphyxia—Interference with oxygen and carbon dioxide exchange.

Anoxia—lack of oxygen, no matter where it is or how it is produced.

Anoxemia—lack of oxygen in circulating blood.

Causes of Oxygen Want:

1. Low oxygen content in inhaled atmosphere
2. Mechanical obstruction to respiration
3. Decreased vital capacity (tuberculosis, emphysema, et cetera)
4. Decreased tidal volume (depression of respiratory center by drugs, inhibiting positions, pneumothorax, et cetera)
5. Interference with diffusion of gases (bronchial asthma, emphysema)
6. Circulatory deficiency (myocardial insufficiency, decreased blood volume due to shock, or hemorrhage)
7. Disturbances of tissue respiration.

Symptoms of Asphyxia:

Respiratory: Immediate increase in volume and rate; expiration becomes forced; depth of respiration is increased by alternate forced inspiration and expiration.

After reaching a maximum, volume and rate decrease and apnea follows the period of shallow breathing. The apnea is broken by a series of violent inspiratory and expiratory gasps—the gasps are repeated until the apnea becomes permanent (Wiggers).

Circulatory: Increase in pulse rate (16 to 12 per cent), followed by a slow, bounding pulse. The blood pressure rises—

(systolic: 30 - 60 mm.)
(diastolic: 10 - 30 mm.)

When the oxygen has been reduced to a critical point, circulatory and respiratory collapse occurs. The pulse becomes rapid and weak; the blood pressure falls. The circulatory effects coincide with great respiratory depression, but definitely precede its complete failure (Wiggers).

Nervous Symptoms: Muscular twitching, rigidity, convulsions

Color: Usually marked cyanosis when asphyxia occurs during anesthesia

Blood changes during asphyxia:

Carbon dioxide content is increased greatly

Oxygen content gradually reduced and depleted

Lactic acid accumulates; alkali reserve of the blood decreases and acidosis results.

Effects of anoxia on respiration when carbon dioxide is removed by soda lime:

No significant change in respiration until oxygen drops to 14 per cent, then there is only a slight change (increase) in rate and volume until 12.5 to 9 per cent. At 9 per cent the amplitude increases. At 8 to 6 per cent there is a hyperpnea which is followed by apnea and death.

Effects of anoxia when carbon dioxide is not removed:

Hyperpnea at 16 to 14 per cent. This is followed by a period of quiet shallow breathing due to lowered carbon dioxide tension which results from initial hyperpnea, resulting in aelsalemia. As the breathing quiets, the oxygen lack again develops and the cycle is repeated, resulting in a periodic type of breathing.

The symptoms and effects of anoxia depend upon the degree of oxygen lack and the rapidity with which it is produced. Anesthesia may modify the symptoms. The effects of anoxia on respiration are not determined in a simple way but involve a series of interacting disturbances. These are:

Reduced oxygen tension

Acapnia

Firmer combination of oxygen with hemoglobin due to lowered carbon dioxide tension

Changes in the *p*H

Reflex changes.

Lack of oxygen depresses the respiratory center initially, normal depth of breathing being maintained through reflex stimulation of the receptors in the carotid sinus.

Oxygen deficiency is stimulating only when extreme and when complicated by acidosis.

Increase in carbon dioxide and decrease in *p*H are stimulating until extreme changes occur, then are depressing (Wiggers).

Results of anoxia:

These depend upon the degree and duration of oxygen deprivation. Haldane says that anoxia "not only stops the machine but wrecks the machinery."

Damage to the cortex occurs in eight minutes of absolute anoxia; to the cerebellum in thirteen minutes, and to the medulla in twenty minutes (Adriani).

In severe cases there is circulatory and respiratory depression, convulsions, coma, hyperthermia and death occurs.

Patients who survive may show permanent signs of damage to the brain, such as mental deterioration, visual defects, Parkinsonism.

In less severe cases these may be transient psychoses, nausea and vomiting, headache.

Color:

Color is an index of the efficiency of respiration and of circulation. A good color is a guarantee of safety. *Never* tolerate *cyanosis.*

Color is noted on the lips, ears, cheeks, finger nail beds, and blood in the field of operation. It is a good idea to check the color of the skin and the blood together.

Cyanosis may be defined as a blue, purple, or even black tinge in the color of mucous membrane or skin, due to the presence of increased quantities of reduced hemoglobin in the blood of the capillaries of the skin. Oxidized hemoglobin is bright red, reduced hemoglobin is a bluish color; this gives the bluish color in cyanosis.

Cyanosis appears when the reduced hemoglobin is present to the extent of 5 grams per 100 cc. of blood. Normally there are 15 grams of hemoglobin to 100 cc. of blood. If there are less than 5 grams of reduced hemoglobin, the skin will not appear cyanotic, no matter how little oxyhemoglobin is present. Thus an anemic patient having a hemoglobin of 30 per cent will not show cyanosis because there is not enough hemoglobin present to have the necessary 5 grams of reduced hemoglobin.

Marked oxygen want may exist without the appearance of cyanosis.

Cyanosis loses its value as a danger signal when the hemoglobin reaches about 80 per cent. With the hemoglobin below 60 per cent the appearance of cyanosis indicates a marked degree of oxygen deficiency.

Individuals presenting difficulties in noting color:

The appearance of cyanosis is hard to detect in children and dark-skinned individuals. This includes the negro, the oriental, and the tanned and sunburned patient. It is also difficult to detect in patients suffering from anemia, jaundice or cardiac diseases.

Florid individuals develop cyanosis very quickly.

In instances where color changes are difficult to detect, it is necessary to use great caution—giving ample amounts of oxygen and being especially careful to maintain a free airway at all times. In such cases the blood at the field of operation is the only guide.

(To be continued)

NOTICE—WHERE TO SEND DUES

In unorganized states the members are to send their dues direct to Gertrude L. Fife, Treasurer, 2065 Adelbert Road, Cleveland, Ohio, making check or money order payable to the American Association of Nurse Anesthetists.

Members in organized states should send their dues to the Treasurer of the State Association, who in turn sends the dues to the American Association of Nurse Anesthetists, Gertrude L. Fife, Treasurer, 2065 Adelbert Road, Cleveland, Ohio.

ACTIVITIES OF STATE ASSOCIATIONS

KANSAS

Third annual meeting held November 18, 1942, at Huston Nurses' Home, Wesley Hospital, Wichita. Viola Baker, President, gave an interesting report of annual meeting American Association of Nurse Anesthetists held in St. Louis in October.

It was voted that present officers serve for the duration.

Following a social hour, the Wesley Hospital anesthetists were hostesses at dinner. In the evening a lecture was given by G. F. Corrigan, M.D., on "Causes of Oxygen Want." Music and other entertainment were followed by refreshments.

COLORADO

Officers elected at meeting held December 19, 1942, Presbyterian Hospital, Denver:

President	Ann McDonald Stevens 1663 Gilpin, Denver
Vice-President	Henrietta M. Moon 950 Marion St., Denver
Secretary-Treasurer	Helen Tubbs 1585 Fillmore St., Denver

MINNESOTA

Meeting held at Deaconess Hospital, Minneapolis, on September 29, attendance sixteen. Ruth Walthers, Minneapolis General Hospital, spoke on "Testing of Bulk Ether." Lunch was served by Palma Anderson and Mrs. Snobeck.

Second fall meeting, St. Luke's Hospital, St. Paul, October 22, with fifteen in attendance. Reports on national convention given by Palma Anderson and Katharine Jurgensen. Dr. Janssen of St. Paul gave a talk on spinal anesthesia. Lunch was served by Kathleen Cleary and Gertrude Porter.

NEW YORK

New Jersey and New York anesthetists will hold joint meeting at Pennsylvania Hotel, New York City, May 26 and 27, 1943, in conjunction with New York and New Jersey Hospital Associations. For further information write Janet B. Dougan, Secretary New York Association of Nurse Anesthetists, Morrisania Hospital, Bronx, N. Y., or Ada B. Kalnoske, Secretary New Jersey Association of Nurse Anesthetists, New Jersey State Hospital, Marlboro, N. J.

PENNSYLVANIA

Annual convention of Pennsylvania Association of Nurse Anesthetists will be held at Bellevue-Stratford Hotel, Philadelphia, April 15 and 16, 1943. For further information write Rose G. Donavan, Mount Sinai Hospital, Philadelphia, Chairman of the Program Committee, or Mrs. Helen Young Walker, Secretary-Treasurer, 1824 Wallace Street, Philadelphia, Pa.

WISCONSIN

Regular meeting of Wisconsin anesthetists held at home of Esther Edwards, Wausau, November 7, 1942, was preceded by tea and social hour. Hilda Moberg, Reedsburg Municipal Hospital, Reedsburg, appointed to serve on Membership Committee to fill vacancy caused by resignation of Elizabeth

Jacke, who has left Wisconsin. Sister M. Odila Diedrich, St. Mary's Hospital, Wausau, was appointed to the Revisions Committee to replace Sister M. Agatha Gerber, who was unable to serve. It was voted to pay expenses of delegate to convention held in St. Louis.

Julia Campbell of Milwaukee gave a paper on "Administration of Carbon Dioxide and Oxygen." Mrs. Ruth Duncan, Madison General Hospital, Madison, delegate to the annual convention in St. Louis, gave an interesting report, and Leone Thielen, St. Mary's Hospital, Racine, read an article on war surgery.

Evening session, beginning with a dinner, was held at the Wausau Club.

Dr. Merritt LaCount Jones, Toastmaster, gave a talk in appreciation of the nurse anesthetisct. Several solos were rendered, and by the courtesy of the Employers' Mutual Insurance Company and Mr. Herbert Ladwig three impressive movies were shown, which gave the impression of being close-ups — Battle of Marshall Island; Bombing of Pearl Harbor; and the Battle of Egypt.

Attendance of eighteen was felt to be good in view of shortage of nurse anesthetists and difficulties of transportation. The meeting in Wausau made it possible for some to attend who otherwise would not have been able to do so.

UTAH

Officers Re-elected for 1943:

President

Mrs. Loretta F. Case
436 "H" St., Salt Lake City

Vice-President

Gladys Hood
Utah Valley Hospital, Provo

Secretary-Treasurer

Mayme C. Garrison
463 "D" St., Salt Lake City

Trustees:

Vilo Redd
Anna J. Hall
Lola McGillivray

MRS. LORETTA F. CASE, President

Utah Association has three members in the service to date: Vera G. Schmidt, Jeane M. Clayton, and Helen Wangsgard.

SOUTHEASTERN MEETING CANCELLED

In view of the increasing difficulties in transportation, the Southeastern Hospital Conference has been postponed indefinitely. The meeting of the Southeastern Assembly of Nurse Anesthetists has therefore been cancelled. The meeting was to have been held in Atlanta, Georgia.

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